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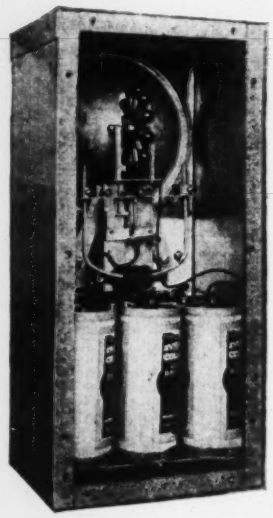

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

Volume 103 NEW YORK, OCTOBER 10, 1929 Number 15

Storm Hazards Become Definite

ONCE more a West Indian hurricane has swept the south Atlantic area, the third in three years. Chance turned its direct path away from the land, enough so that populated regions escaped its central fury and met only its fringes, though even these were laden with gales and deluges of rain. The flood and storm damage which resulted from this fringe attack proves to have been serious and of wide extent, though it vanishes before the havoc wrought on the earlier occasions. This latest storm visitation shows how definitely the hurricane hazard must be counted upon in our southeastern regions. Three years ago the enormously destructive September hurricane which swept Miami came in the guise of a rare, hardly-to-be-repeated Act of God. When it was duplicated by an even greater hurricane disaster in 1928, which after sweeping Palm Beach drowned out the Belleglade edge of Lake Okeechobee shores, belief in the rareness of the phenomenon was shaken. After this year's storm it can no longer be doubted that these tremendous storms must be accepted as frequent visitors. It follows that all engineering works in the affected areas ought to be planned to provide against this hazard. Buildings, structures and public services will be unsafe unless built with hurricane strength; hydraulic works and construction operations that do not take extreme flood and wind effect into account will prove to be potential sources of disaster. As yet no rules or basic design data have been formulated to recognize these conditions, but it seems quite possible to make a substantial beginning in this direction by proper co-operation of Southern technical men.

How City Requirements Grow

STRIKING illustration of the ceaseless growth of city needs and corresponding expansion of the engineering works required to satisfy them appears in the authorization by the New York City authorities on a single day of three enterprises, each of exceptional size: a sewage-treatment plant on Ward's Island, a great viaduct (or, rather, series of bridges) to connect the island boroughs of Queens and Manhattan with each other and the Bronx, and a costly street-widening operation to create a new major thoroughfare. This is done while the city is yet in the midst of a half-billion dollar subway project, is proposing a further one of similar size, and is constructing an elevated express highway several miles long, besides moving toward the construction of a vehicle tunnel under the East River and across Manhattan Island—to mention only some major items of current construction and planning. Providing for human existence in a great city evidently calls for thinking in terms of billions, an order of magnitude that not long ago was in the realm of idle fancy so far as the engineer was concerned. Even in smaller communities the years have seen the dimension of popular necessities grow beyond previous conception, so much as to strain the engineer's powers of imagination and often cause him to shrink back from reasonable and proper forecast. No sign has yet appeared to indicate that the rapid growth of modern city plant is to end, or that it will proceed at more moderate rate. If the pace is maintained, the engineer will continue to need a robust and unfettered imagination in order to foretell the demands which communities will place on engineering service in the years to come.

A Way Out

FOR decades the garbage and refuse disposal of San Francisco has been in a mess. The city fathers have floundered about in it without getting out. After backing and filling on various plans in the last two or three years they have confessed their inability to decide what to do and have passed the matter on to the voters, but not on a single clear-cut proposal. Instead, four questions are to be submitted, while to these a fifth has been added by an initiative petition signed by the requisite number of voters. The questions are such that conceivably two opposing proposals might be adopted. Four of the proposals, as stated on p. 511 of our issue of September 26, are for (1) incineration, (2) municipal collection, (3) municipal disposal, (4) a privately built and operated plant, with city right to buy on terms to be decided later. To these the initiative petition adds a vote on disposal by fill-and-cover, on land to be acquired for the purpose. Apparently, the voters are to be given no competent information, official or otherwise, on the relative costs of the various plans. To this they are entitled. However else they vote, they would do well to vote for municipal collection and disposal. By so doing they would put San Francisco in line with the best municipal practice at home and abroad. In addition, it is probable that they would also make possible a material reduction in the cost of service. As matters now stand, householders are paying the private scavengers a service fee which includes all the cost of collection and most of the cost of disposal, and the disposal is so woefully inadequate that a court injunction against the operation of the ancient and overburdened incinerator has long been hanging over the city. The action of the authorities in shifting the responsibility to the voters, regrettable as it is, will point the way out of the mess if the vote goes strongly for both municipal collection and disposal.

County Engineering

IN THE development of public services nothing is more remarkable than the evolution of county engineering. Some years back the work of the county engineer in many districts was made up of a miscellaneous group of duties rarely including anything of major importance and offering little attraction or opportunity to men of large

capacity. Road demands have brought a profound change, and today most county engineers administer large expenditures and carry the responsibilities of a good-sized business. Supplementing several prior sketches of present-day county engineering, an outline in this issue of the work in Mecklenburg County, North Carolina, gives a fresh picture of the importance of this branch of the public service. Its problems, both technical and administrative, approach those of state highway service. Moreover, it stands in peculiarly intimate relation to the direct necessities of the people; the convenience and efficiency of the county dweller in particular is markedly dependent on the ability and wisdom applied to this work. County engineering is still evolving, but even today it presents the opportunity of a career in which the engineer may find satisfying scope for all his talents.

Shipping Freight Cars

THE freight-car transport service inaugurated between New Orleans and Havana early this year marks a new departure in such services. Car ferries of various sorts have been in use at other points for many years, but they have departed little from the earliest type developed, a vessel with a single deck, either open or inclosed depending upon the character of the service, to which the cars are switched directly from yard tracks by way of a float bridge. The capacity of this type of car ferry is limited to the capacity of one deck, and consequently the cost per car is high where the vessel must make a long run between terminals. The new ferry at New Orleans is designed to overcome this handicap. In it the cars are placed on three decks and in the hold, and the float bridge is replaced by a crane which brings the cars over the ship side and lowers them into the hold. Skips in which whole cars of coal or grain are picked up and dumped are not uncommon, but this is the first instance in which the much more complicated combination of lateral and vertical movements has been attempted. The loading is of necessity slower than with the single-deck end-loading ferries, but when it is realized that such a ship, having a capacity of 90 to 95 cars, can be unloaded and reloaded in one working day it becomes apparent that it has great possibilities in such a service as that between this country and Cuba.

Curbing Civil Service Commissions

RECENT reversal by the Supreme Court of Michigan of a Circuit Court decision which had granted a mandamus to compel the fire department of the city of Detroit to reinstate a discharged employee clears up a long-standing misapprehension of the power of the local Civil Service Commission and materially curbs the power it had assumed. A fire fighter was discharged for "intoxication and for the good of the service." On appeal to the Civil Service Commission his reinstatement was ordered on the ground that the employee was not intoxicated, but the fire department refused to reinstate, whereupon mandamus proceedings calling for reinstatement were brought and sustained in the Circuit Court. This is the decision the Supreme Court reversed, on certiorari, stating that the Civil Service Commission is limited to inquiring into the motives or reasons for the discharge and not into the sufficiency of the evidence on which the trial board of the fire department acted. The Civil Service Commission, says the decision, is not concerned with the guilt or innocence of the employee except as that fact aids it in determining whether the removal was for some unlawful purpose or reason. In other words, it is authorized only to inquire into the good faith of departmental heads in removing their employees, not to correct their judgment. The Civil Service Commission is limited by charter to the determination of two questions: (1) Was the employee discharged for political or religious reasons, or (2) Was he discharged for other reasons than the good of the service? The employee by this ruling gets one trial only and that before the trial board of the department. The duty of the Civil Service Commission is to see that this trial body does not act "fraudulently, arbitrarily or capriciously," for such conduct would justify the commission in finding that the removal was for the reasons prohibited by statute. If the evidence is to be reviewed, that is a function of the courts of justice, to which an employee may appeal, the Michigan Supreme Court holds.

For a long time Detroit department heads have viewed with concern hearings before them and the commission, both being virtually trials. Usually the employee was called upon to say but little, while the department head was frequently placed in an embarrassing position by the discharged employee's attorney or by members of the Civil Service Commission, finding himself not only put on trial but also in danger of having his honest efforts to obtain efficiency nullified by a commission that becomes attorney, judge and jury for the discharged employee.

This is not the theory of the civil service, but it is the way it too often works in practice, converting a remedy for an evil into another evil—which on the whole is generally a lesser one but unquestionably lessens responsibility of department heads and threatens the efficiency of their departments. A new conception of the civil service is to make it a continuing agency for efficiency, instead of an initial agency for obtaining competent public employees and once in office making it almost impossible to get them out, no matter how inefficient they are. This plan, however meritorious and needful it may be under present governmental conditions, is largely a shifting of responsibility and power from a department head to a commission which at best is remote from the administrative problems of the various city departments. It also tends to substitute one evil for another, but the choice between the two in this case is clearer than in the other.

Although analogies between private and public business management are likely to be misleading, it seems safe to say that few successful private business organizations today put their department heads in such a defenseless position as regards inefficient employees—much less those who are constantly or temporarily irresponsible through bad habits—as most of our city, state and federal department heads find themselves in when acting under civil service commissions. We do not for a moment advocate the abolition of such commissions. Nor do we presume to say that conditions at Detroit have not been exceptional. In fact, we think they are exceptional in that the Detroit Civil Service Commission has usurped powers not given it by the city charter—powers, however, given in the charters of some other cities, which specifically make civil service commissions trial courts to hear and pass upon charges brought by department heads. But while we favor curbing abuses, especially overstepping of powers, practiced by civil service commissions, we must reiterate what we have already said in their

favor as the indicated better choice between two evils—a choice that will become less and less necessary as our municipal, state and federal governments are elevated to a higher plane by the more discriminating choice of representatives by the electorate and a more intelligent, insistent and constant demand by the people for honest and efficient government.

What Is Cost?

ESTIMATES of cost of construction projects serve various functions. They are used first as a basis for selecting the best from several alternative projects, later to give a basis for appropriations of money, and finally to set up the total cost of the project as executed. The common conception is that any estimate suitable for appropriation and contract letting is adequate for all of these purposes. Certain practical facts make this questionable, however, and present the problem of determining what is cost.

Public work is mainly at issue here. In private work it is common to consider all elements of cost, for unless this were done the officials in charge would deceive themselves as well as the organization which they serve. Thus, a railway bridge reconstruction estimate takes account of interest, salvage and interference with traffic, all of which are factors in the ultimate cost. In public work these factors are apt to be ignored, yet there is no reason except official habit why the public should be less fully served in the matter of estimates and plans for work than the stockholders of a corporation.

A pertinent instance of public work is the construction of a municipal rapid-transit subway. Let us suppose that the line is located under streets, and therefore no important land payments are involved. Estimates of cost as they are commonly prepared and published represent the sums necessary to be paid contractors, and nothing else. But it is quite proper to ask whether interest during construction should not be added in any such estimates, so that not only the original project but also the comparison of alternatives and the final accounting will be correct. Admitting that the specific method of application of this item must depend on circumstances, nevertheless the general principle of including it would appear to be sound and necessary.

But a second and more important question in the case in hand is whether business interruption, gain or loss to private owners, and appreciation or depreciation of other traffic agencies are to be considered. They are not included in any estimates of cost of such work that we have seen, and in fact sometimes two alternative schemes are compared as to location, design or method of construction without regard to these elements of cost. For quite the same reason, evidently, any difference in operating cost should be added as a capitalized value, in order to make a proper comparison. Unless all these elements are included, cost estimates are likely to be seriously misleading, with danger of bringing about not only wrong decisions on the part of the projectors of the enterprise but also misconceptions by the public and the appropriating authorities as to the best course of action. Were a railroad, in rebuilding a bridge, to compare merely the bare contract costs of two schemes having different interfering effects on traffic or involving different elements of distance, curvature, grade or maintenance, the result would obviously be unsound. No railroad would follow such a course. Should any public enterprise be less careful or true in its accounting?

In summary, unless financial calculations are made to show true total cost, they are not such as to lead to sound engineering decisions. Incomplete cost estimating is not uncommon in public works, possibly because the first objective is to find the course involving the lowest money appropriation. This course may lead to false engineering decisions, to erroneous appraisal of financial feasibility and ultimately to incorrect reporting of operating costs, with all the possibility of misleading conclusions that the latter implies. Public work will not be on a wholly sound basis until it is regularly based on true estimates of total costs; and this in turn becomes possible only through clearer understanding than is now common as to what is cost.

Numbers and Quality

DR. IMHOFF'S statement that "the United States has far more new and good sewage-treatment plants in operation and under construction than any other country," made in our issue of last week at the opening of his notable summary of what he saw and learned during a recent visit to North America, raises the question, Why is this so? He makes partial answer by saying that the "great technical success" of our sewage-works is due mainly to the co-operation of consulting engineers, state sanitary engineers and city officials. This refers to the success of the works, rather than their number. Doubtless if he were questioned Dr. Imhoff would credit the same three classes of men with material contributions also to the number of plants, particularly the promotional work of state sanitary engineers and the boards or commissioners of health under whom they serve.

Dr. Imhoff did not say that we have more sewage-works than any other country, but more "new and good" ones. By these qualifiying words he graciously passed over the many plants, new and old, that are operated with a degree of ignorance and neglect that is shameful. Dr. Imhoff does say, pointedly enough, that he "did not see any really digested sludge from separate digestion tanks on his trip," but he added that this could be easily remedied by heating the sludge, a procedure already coming into use in new plants. He also remarked on the high power consumption in our activated-sludge plants and the possibility of reducing it by improving details.

Whether the United States has more sewage-works in relation to its needs than have other countries Dr. Imhoff did not venture to say. That was wise, because it would be difficult to make a comparison on the basis of relative needs and harder yet to say how fully the works built meet the needs—even if the bare number of works in the various countries of the world were known. As an off-hand opinion we should say England has more sewage-works than the United States on any reasonable basis of comparing mere numbers; and that the same may be true of parts of Germany. Compared with other European countries we should suppose the United States to be ahead, again in mere number of plants. Canada and Australia are perhaps quite in line with the United States in number of sewage-works in comparison with needs. Conditions are so different in nearly all South American countries, as also in Africa and Asia, as to make almost absurd any attempts at comparison.

Finally, considering numbers of works for which there is need, and efficiency of operation of those already built, the United States still has far to go. In general, our cities are building far better than they are operating. The lag is being taken up, but not with sufficient rapidity.

Dismantling Two Long Suspension Bridges

With No Precedents as Guides, the Contractor Removed Structural Members and Wire Cables on Mount Hope and Detroit Bridges in Record Time—Cable Was Separated Into Strands and Flame-Cut Into Sections for Convenient Handling

IN MARCH of this year engineering circles were shocked to learn of serious breakages in the cable wires of two important highway suspension bridges then under construction. News of the breakages was followed by a cessation of work on both structures and later by the decision to dismantle the bridges and replace the suspension systems with satisfactory wire. Interesting operations of unprecedented kind were involved in the dismantling. Both structures utilized the same kind of wire, a heat-treated product of high elastic limit, heretofore untried in suspension bridge service. The Mount Hope bridge, near Providence, R. I., which had a center span of 1,200 ft., was within about twelve months of completion, requiring only the placing of the concrete floor slab. The Ambassador bridge at Detroit, whose suspended span of 1,850 ft. ranked second only to the 3,500-ft. span of the Fort Lee Hudson River bridge under construction in New York City, was not so near completion, although its cables were finished and about one-third of its stiffening truss and floor steel was in place. The major wire breaks on both bridges occurred in the anchorages near the tangent point of the strand shoes, although numerous breaks were subsequently discovered under the cable bands in the main span at Detroit. No satisfactory explanation of the wire breakages has yet been found. Many specimens of single wires and of strands were furnished the Bureau of Standards from the Mount Hope bridge, and metallurgical and physical research investigators are at work studying the problem.

The same contractor was erecting both structures, so that when the decision came to replace the cable wire, both dismantling operations were speedily got under way. This article describes the methods evolved by this contractor on two pieces of work for which there were no precedents available as guides and yet which required the utmost dispatch in their execution.

Complete details of the bridges and the cable breakages have previously been given by articles in *Engineering News-Record* as follows: design of the Mount Hope bridge, April 12, 1928, p. 585; design of the Ambassador bridge, Sept. 27, 1928, p. 461; tower erection, Ambassador bridge, Jan. 31, 1929, p. 186; first news of wire breakages, March 28, 1929, p. 516; discontinuance of work at Detroit, April 4, 1929, p. 564; and analysis of breaks at Mount Hope, April 11, 1929, p. 602. —EDITOR.

DISMANTLING operations on the Mount Hope and Ambassador suspension bridges, near Providence, R. I., and Detroit, Mich., respectively, occasioned by wire breakages in the cables, have been completed and reconstruction work is now under way on both bridges. This article covers the methods used in dismantling the two structures, and in the case of the Mount Hope bridge considers the precautionary measures taken to safeguard the structure after the first breaks were discovered. Precautionary measures were not considered necessary at Detroit, since the load being carried was only about one-third of that at Mount Hope.

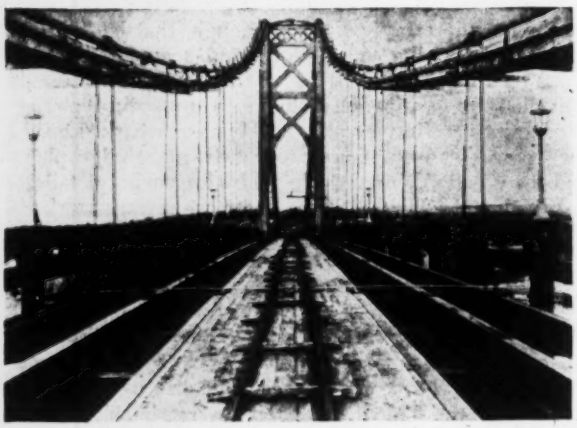


FIG. 1—MOUNT HOPE BRIDGE JUST PRIOR TO DISMANTLING

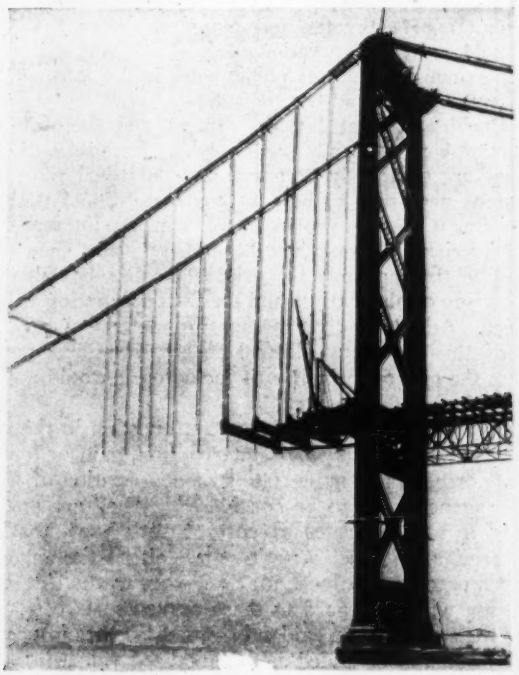


FIG. 2—AMBASSADOR BRIDGE BEFORE DISMANTLING

Four of fourteen panels of floor steel that had been erected before dismantling began are still in place.

Although the same contractor carried out both jobs, there are marked differences in the dismantling procedure. The work was new, and the designs of the two bridges differed. At Mount Hope, the stiffening trusses were erected complete in two-panel lengths, whereas at Detroit a design was used which resulted in the erection of the bottom chords of the stiffening trusses along with the floorbeams, which were hung from the suspenders, as the initial operation. The separate wire strands in the Mount Hope cable were heavier than the strands at Detroit; the anchorage eyebars were installed with flat side horizontal at Mount Hope and vertical at Detroit; the anchorage was concreted in at Detroit, whereas it was

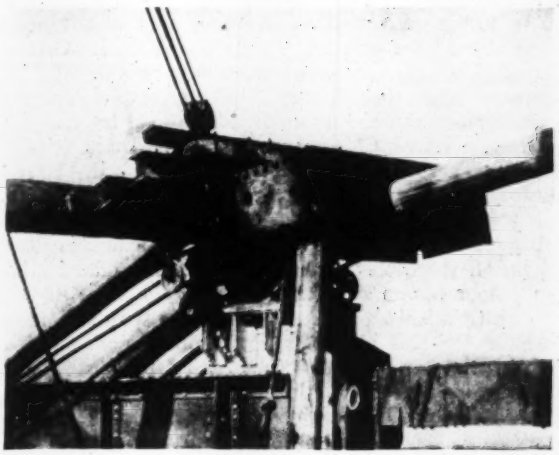


FIG. 3—HOLDBACK YOKE IN FRONT OF CABLE-BENT SADDLE, MOUNT HOPE

Four holdback ropes are visible and four similar ones are attached at the far side of the yoke.

to be sand-filled at Mount Hope; and there were several other major differences.

Mount Hope Bridge

The Mount Hope bridge is located about 15 miles southeast of Providence, R. I., and spans the strait connecting Mount Hope and Narragansett bays. It is a highway toll crossing of wire-cable suspension design with a 1,200-ft. suspended main span and 504-ft. suspended side spans. Cable-bent towers are used at the ends of the side spans, the backstay portion of the cable between these towers and the anchorages covering a horizontal distance of 220 ft. The main towers, of structural steel, are 284 ft. high and carry two 11-in. cables 34 ft. apart, each cable consisting of seven strands of 350 No. 6 wires. The stiffening trusses are 18 ft. deep, discontinuous at the towers, and fabricated in two-panel lengths totaling approximately 38 ft. Floorbeams placed about 19 ft. on centers rest on kneebraces, while the stringers and transverse slab beams are erected on top of the floorbeams.

At the time of the discovery of the wire breaks, the bridge was substantially complete with the exception of the concrete floor slab. Forms and reinforcing steel in considerable quantities were in place and the cables were stressed to about 32,000 lb. per sq.in. (the intended maximum working stress was to be 80,000 lb. per sq.in.). Because of this comparatively heavy load and because the cable wires were continuing to break at intervals, precautionary measures were immediately devised to relieve the strain on the cables. At the same time, since the breaks were localized near the strand shoes in the anchorages, hairpins of new wire were spliced to the broken ends.

Precautionary Measures—Two systems of holdbacks were devised to relieve the strain on the cables. One system was applied just ahead of the cable-bent castings on the side spans; the other was placed on the backstays and consisted of yokes bearing against cable clamps attached with each yoke tied back to the anchorage eyebars.

The yoke of the holdback system at the cable-bent tower is shown in Fig. 3. It was made up of two I-beams placed flat transversely to the cable, one above and one below the cable and inclosed into a box shape by the bolted plates shown in the illustration. In this box and on each side of the cable two sheaves were mounted in a flat position on pins which were seated at the top and bottom in the webs of the I-beams. Around each of these four sheaves 1¼-in. plow-steel ropes with hemp centers were passed, running down to the anchorage eyebars. Fortunately these eyebars had not been concreted in. Also, since they were installed in a flat position, the holdback ropes were clamped around the head of the bottom eyebar of a pair. Thus each cable-bent holdback system consisted of eight parts of 1¼-in. rope at each of the four anchorages. Since each holdback rope was fitted with a turnbuckle with an effective strength of 25 tons, the load carried in each anchorage by the cable-bent holdback system was limited to 200 tons.

The structural-steel yokes of the backstay holdback system were tied to the anchorages by 1¼-in. ropes with steel centers and plow-steel strands and were designed to remove all of the remaining load from the bridge cable, should this prove necessary; it was estimated that twelve yokes, each connected to the cable by two ropes stressed to 50 tons, would completely remove all load from the main cables. Although only one of the twelve proposed yokes was actually applied, the method of application was interesting enough to record.

Briefly, this involved placing the yokes around the backstay, connecting them to the anchorage by two-part cables, stressing these cables by means of hydraulic jacks and holding the yokes in a stressed position by heavy cast-steel cable clamps. The apparatus necessary to effect this is shown in Fig. 4. It consisted of three yokes, the upper two of which were for erection purposes only. The top and bottom yokes were connected by angles into a rectangular steel frame; the middle yoke was loose,

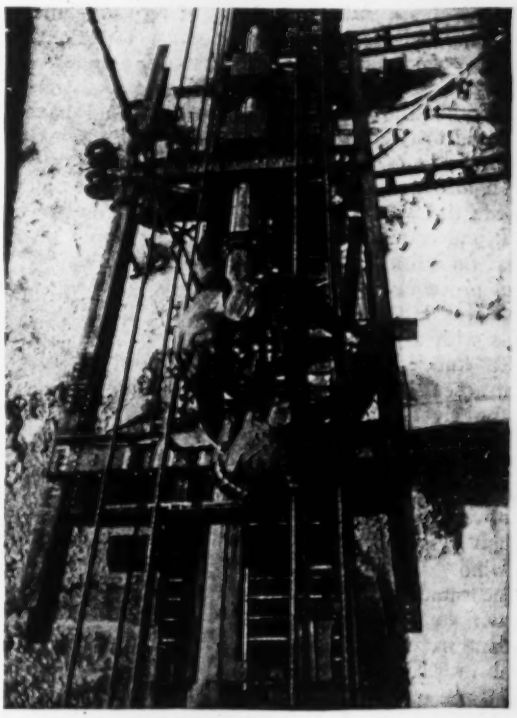


FIG. 4—REMOVING THE EQUIPMENT USED TO INSTALL BACKSTAY HOLDBACKS, MOUNT HOPE

Yoke upon which men are working is ordinarily not attached to side angles. Top yoke has been removed. Bottom yoke rests against cable clamp; end of holdback rope, which has been cut off, can be seen in bottom yoke just inside of right-hand side angles.

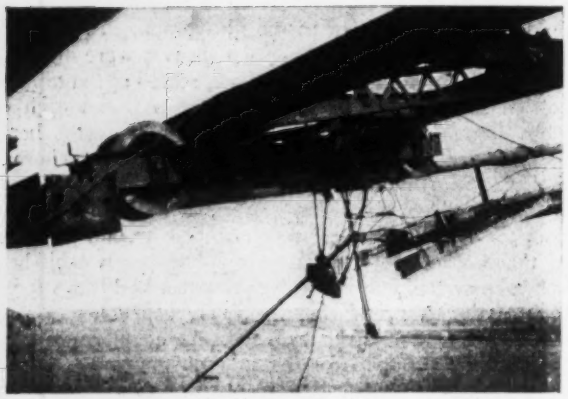


FIG. 5—TRAVELERS AT MOUNT HOPE DESIGNED TO RUN ON CABLES

Sheave shown used for setting truss sections. Another sheave just out of picture at the right carried falls for handling floorbeams and stringers. Cable bent holdback yoke at left.

but rested against a cable clamp as shown. This middle yoke, being fixed in position by the cable clamp, served as a reaction girder for hydraulic jacks set between it and the upper yoke. As these jacks were run out, they moved the top yoke and therefore the rectangular frame which included the bottom yoke up the cable, stressing the holdback ropes attached to the latter. These jacks, being run up to a gage load of 50 tons, placed a corresponding load on the holdback ropes. A second cable-clamp was then applied below the bottom yoke, holding it in the stressed position and permitting the release of the jacks and the removal of the two top yokes and the side angles of the rectangular frame. Thus one set of holdbacks was in position and the upper two yokes were free to repeat the operation. Instead of removing the upper two yokes, it would have been possible to leave them in position and merely extend the side angles of the rectangular frame down to another bottom yoke. By this method these 100-ton holdbacks could have been increased to twelve on each backstay cable.

Dismantling Travelers—With only one of the backstay holdbacks in place, further failures in the cable wire ceased; the contractor then discontinued the preventive work and concentrated all efforts on dismantling. The usual procedure for removing rivets was either to cut off the heads with a pneumatic chisel or to knock them off with blunt-nosed tools. The shafts of the rivets could then be punched from the holes and replaced with bolts. The smallest possible number of bolts was used in general only enough to steady the steel in the wind.

The same travelers used in erection were available for the dismantling. They were unusual in that they were designed to run on the cables rather than on the deck, the ordinary deck traveler being considered too heavy for the comparatively light cables of the bridge. Also, the floor design of the structure was such that a deck traveler would have had to boom out about 40 ft. to set truss sections and floor steel in advance.

A view of the traveler is shown in Fig. 5. Grooved cast-steel wheels are mounted between a pair of 15-in. channels, while the framework of the traveler, spanning from cable to cable, consists of two 18-in. I-beams spaced by four pairs of 12-in. channels running parallel to the cables. These 12-in. channel frames carry the hoisting sheaves, those shown in the accompanying illustration being 3 ft. off the center line of the cable and used for setting truss sections. Another set of sheaves 10 ft. 7½ in. off the cable center line carries the falls for handling floor beams and stringers.

Two travelers were used on the main span and one on each of the side spans. Each required four lines, an uphaul cable, a downhaul cable and two hoisting falls. Two three-drum electric hoists placed on the pier at the base of each main tower furnished twelve of the sixteen drums necessary to supply these lines. The four other drums were obtained by placing two-drum electric hoists on the approaches to operate the uphaul and downhaul cables of the side-span travelers. All uphaul cables were three-part lines; the downhaul cables on the center-span travelers were two-part lines and on the side-span travelers single lines.

Stiffening Trusses and Floor Steel—Removal of structural steel was practically the reverse of erection. Since the steel had not yet received its first field coat of paint, it was necessary only to freshen up the match marks on the truss sections. On the other hand, new match marks were given to floorbeams, stringers, laterals and plates.

The stringers and laterals, as well as the floorbeams at stiffening-truss splices (alternate floorbeams), were removed on the first pass of the travelers, followed by the stiffening trusses and the remainder of the floorbeams on the second pass. For the first operation, the side-span travelers started at the cable-bent towers, whereas the main span travelers started at the center of the span, all working toward the main towers. When all had arrived at the main towers, there remained the stiffening trusses and the alternate floorbeams at the suspenders to dismantle; this steel was lowered as all of the travelers worked away from the main towers. By

FIG. 6—DISMANTLING TRAVELERS WORKING AWAY FROM MAIN TOWERS, MOUNT HOPE

Note that side spans are down except for one panel. Before the last ten panels in main span could be removed, the main tower saddles had to be jacked shoreward 10 in. to maintain the system in balance.

this procedure the suspension system was kept balanced at all times. Also, the steel was piled in the storage yard in the order in which it was to be re-erected.

The truss sections were removed in two-panel lengths (38 ft. long) as they had been erected. They had been connected to the suspenders by sockets attached to the gusset plates at the panel points so that the dismantling operation involved lifting the trusses a short distance to disengage the sockets and then lowering away to the barge below.

Before the last ten pairs of truss sections at the center of the main span could be removed (all the side-span

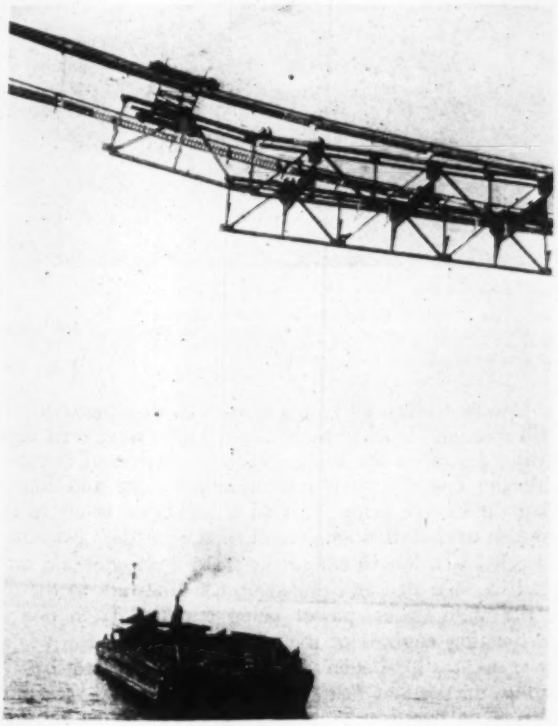


FIG. 7—TRAVELER LIFTING TRUSS SECTION FREE OF SUSPENDERS, MOUNT HOPE

Note alternate floorbeams at suspender points. Floorbeams at splice points were lowered on first pass of traveler. Truss section has just been deposited on barge.

trusses having been previously taken down as shown in Fig. 6) the saddles on the towers had to be jacked back 10 in. toward the anchorages—the reverse of the operation performed during erection. Graphite had been spread on the base plate when the saddles were erected, so that two 25-ton screwjacks easily moved them the required distance (Fig. 8). After these ten sections of stiffening trusses had been lowered, jacking was continued for 10¼ in. more in order to restore the towers to a plumb position.

The third dismantling operation consisted in removing the suspenders and cable bands. The number of each suspender was stamped on the socket with a letter to indicate whether it was the long or the short member of a pair; suspenders were dropped to barges and stored on the Portsmouth shore. Cable bands were dragged up the footwalk to the towers and lowered to the piers for for storage.

New Footwalks—Before actual work could commence on cable removal new footwalk cables had to be erected, since the old footwalk cables had been cut up into suspender ropes and the footwalks hung from the bridge

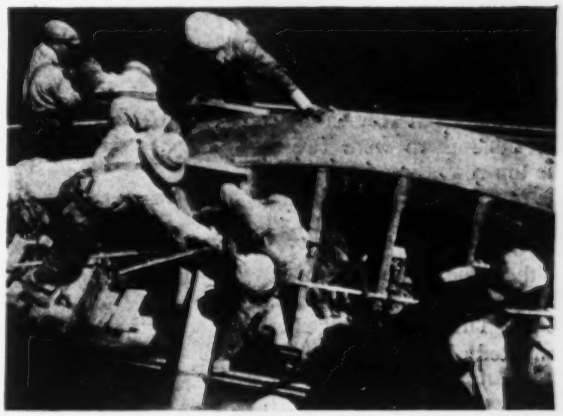


FIG. 8—JACKING THE MAIN TOWER SADDLE AT MOUNT HOPE

cables by wire rope lashings at 20-ft. intervals. The new footwalks cables, two for each walk and 2 in. in diameter, were pulled across the footwalk from the Bristol end, fastened to the original footwalk cable anchorages at the Portsmouth end and pushed off the walk so that they hung below it. Then, adjusting from the Bristol ends, these ropes were tightened until they picked up the footwalk and relieved the strain on the lashings. The final operation consisted in making the ropes fast to the Bristol anchorages.

Cable Removal—Since there was no necessity for removing the cable wire intact, the most rapid means of dismantling was adopted—namely, separating the cable into strands and cutting the strands to convenient lengths by means of oxyacetylene torch. A total of fourteen strands, seven to each cable, was dismantled in six working days and the entire 700 tons of old wire was transferred to a large packet barge and towed away.

At the time the cable dismantling began the two cables were in their original unloaded position and bound only by the three turns of seizing wire which had been put on at 3-ft. intervals after the squeezing. Upon removal of these permanent seizings each 11-in. cable became essentially seven strands, each 4 in. in diameter and about 2,820 ft. long from strand shoe to strand shoe. Each wire weighed about 1 lb. to every 10 ft., hence the weight of the 4-in. strand of 350 wires was approximately 35 lb. per foot. It was decided that a weight of about 500 lb.

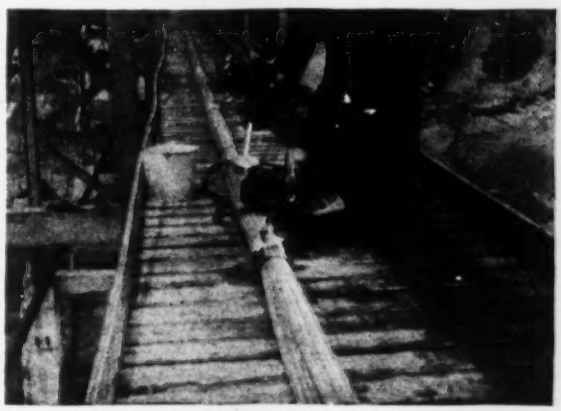


FIG. 9—CUTTING A STRAND INTO 15-FT. LENGTHS AT MOUNT HOPE

Helper moves sleds carrying gas tanks and stands by with pail of water to put out any fires in footwalk.

could be economically handled, and the length of such a section, 15 ft., was found not to be unwieldy.

As the seven strands lay in the cable there were two in the top row, three in the middle row and two in the bottom row. One of the top strands was first raised from the rest of the cable by applying a 50-ton pulling-jack to the strand shoe. The jack arrangement consisted of a yoke placed just ahead of the shoe attached to the jack which lay parallel to the anchorage eyebars, its lower end connecting to a large hook which passed around the pin at the lower end of one of the eyebars in the first link of the anchorage.

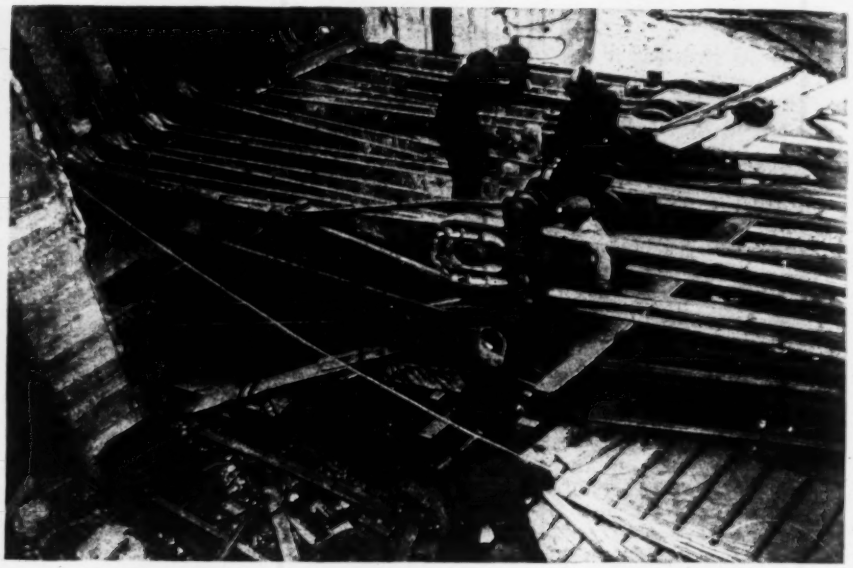


FIG. 11—REMOVING PIN FROM A STRAND SHOE AT DETROIT

Note yoke ahead of strand shoe and attached to hydraulic jack anchored to rear pin of anchorage eyebar. Note also concrete adhering to eyebars; 150 cu.yd. had to be cut out before the dismantling work could begin. At bottom in foreground the take-up screws on the footwalk anchorage are visible.

By pulling a few inches on the jacks at both ends of the strand the sag in both the main and the side spans of that particular strand was lessened and the strand was raised above the six others. In this position two light wire seizings were applied 6 in. apart every 15 ft., followed by a third seizing placed at the center of each 15-ft. length. With the strand shoe thus pulled back, the shims which were in place between the shoe and the eyebar pin could be removed and the pin driven out. Slacking off on the jacks then allowed the strand shoe to go ahead of its normal position, and as a consequence the strand came to rest on the footwalk, the new footwalk cable having been designed for the additional load of 35 lb. per foot. Then, since most of the load was on the footwalk, the strand was removed from the cable-bent saddles by man power and from the main tower saddles by a small jinniwink.

With the strand lying on the footwalk, four gangs with ordinary acetylene torches cut the strand into 15-ft. lengths, burning between the two seizings 6 in. apart. One gang started at each anchorage and worked toward the towers while two gangs started at the center of the main span and worked each way. There were thus eight cutting gangs on the bridge, each consisting of the man with the cutting torch and a helper. In addition to other duties, the helper carried a bucket of water to extinguish fires started as a result of the cutting operations.

Each 15-ft. length cut in the main span was laid on a small wooden sled and pulled up the footwalk to the top of the main tower, power being supplied from one of the hoisting engines at the tower base. On top of the tower a small wooden derrick (also operated by the engines on the pier below) lowered the strand section to a barge anchored at the pier.

In the side spans the burned sections were placed on sleds and dragged down the walk by hand to a point near the anchorage, where they were lowered.

At the time of commencing cable dismantling a tentative schedule was arranged which allowed five minutes to cut a length, five minutes to move the sled, ten minutes to drag the length to the towers and ten minutes to lower. In actual practice it required from four to five minutes for each cut, and three cuts were made before moving the tanks once. The tentative schedule was followed very closely.

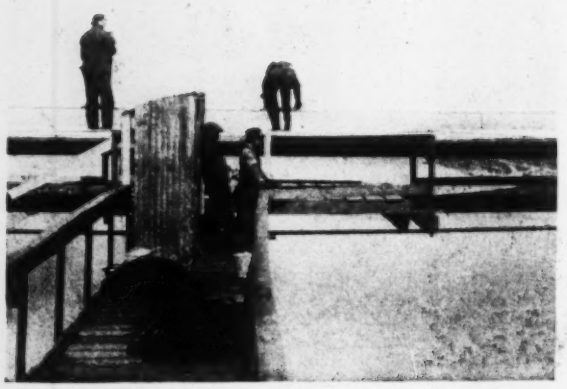


FIG. 10—A STRAND JACKED FREE OF THE CABLE IN THE MAIN SPAIN AT DETROIT

Cross footwalk in foreground.

The Ambassador Bridge at Detroit

The Ambassador bridge, over the Detroit River, joining the city of Detroit to the border cities of Canada, has a main suspended span of 1,850 ft. and unloaded backstays. Each main tower, built of steel, is 363 ft. high above the masonry pier. Stiffening trusses with a panel length of 24 ft. $2\frac{3}{8}$ in. and a depth of 22 ft. are used. Stringers spaced 4 ft. 8 in. on centers and fabricated in two-panel lengths rest on top of the floorbeams, long stringers being adopted to eliminate danger of deformation in the connections during passage of the erection traveler. The floorbeams are single-web plate girders, to the ends of which the bottom-chord gussets of the stiffening trusses are attached in the shop. By virtue of this arrangement the traveler on its first pass

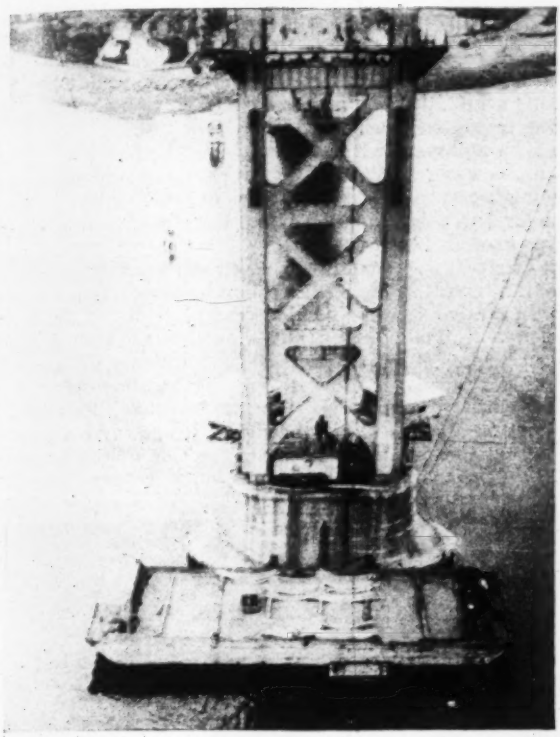


FIG. 12—SEVERED SECTIONS OF CABLE ON BARGE AT BASE OF MAIN PIER, MOUNT HOPE
Note houses on far side of tower inclosing hoists which operate the travelers.

hung the floorbeams from the suspenders, hoisted the bottom chord into the space between the gussets, set the laterals and enough stringers to run on, and proceeded. The bottom chords are spliced at main panel points and fabricated as straight members approximately 48 ft. long. Each of the two cables of the bridge comprises 37 strands of 206 No. 6 galvanized wires, of the same size and manufacture as those used on the Mount Hope bridge.

The Detroit bridge was not so far advanced toward completion as was the Mount Hope bridge when work was ordered stopped on March 1. According to estimates, the cables were stressed to about 10,000 lb. per sq.in. Precautionary measures such as used at Mount Hope were therefore not considered necessary, and dismantling work was immediately begun.

Dismantling Structural Steel—Fourteen panels of structural steel similar to those shown in Fig. 2 and extending outward approximately 340 ft. from each main tower were in place when dismantling work began. This steel comprised floorbeams, bottom chords of stiffening trusses and four lines of stringers. No riveting had been done, hence removal of the structural steel was easily accomplished. The procedure was the exact reverse of erection, the deck travelers lowering the stringers, bottom chords and floorbeams in sequence to barges in the river below. Structural steel dismantling began on April 2, and was completed on April 10.

Cable Wire Removal—The anchorages had been completely concreted in, so that before any steps could be taken to release the cable strands the first link of the eyebar anchorage chain had to be exposed. This involved cutting away 150 cu.yd. of concrete in each of the four anchorages, a task accomplished by the use of pneumatic hammer drills. A view of the east Detroit anchorage with the concrete removed is shown in Fig. 11.

As at Mount Hope, the footwalks were lashed to the cable, the footwalk cables having been cut up into suspenders. Two 1½-in. diameter wire ropes were therefore erected to support each side of each footwalk. This operation was unusual because in order to take up the great stretch in these new ropes and to lift them sufficiently to carry the footwalks, ratchets and turnbuckles were necessary over the tower saddles, while at the anchorages the ropes were strained by steel cable falls and hydraulic jacks. Take-up screws fitted with 7 ft. of thread were provided in all anchorages and it was necessary to use about half of the available take-up before the footwalks were properly swung.

The cable was separated into its various strands by operations similar to those used at Mount Hope. Yokes placed in front of the strand shoes in both the American and the Canadian anchorages were connected to 40-ton jacks, the opposite ends of which were hooked over the rear pins of the first anchorage eyebars (Fig. 11). A 42-in. movement was available in the jacks, and after the shoes were pulled back, permitting removal of the pins, jacking was continued until the strand shoes had moved backward approximately 2 ft. in each anchorage. This jacking raised the strand about 1 ft. above the rest of the cable in the main span (Fig. 12) and from 2 to 3 ft. above in the backstays. As the jack was eased off the strand was laid on the footwalk for the greater part of

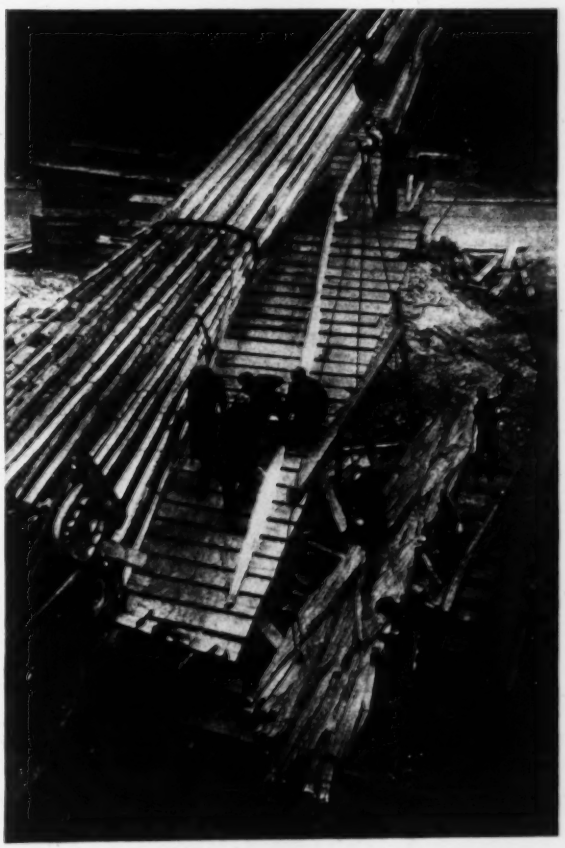


FIG. 13—CUTTING A BACKSTAY STRAND INTO 30-FT. SECTIONS AT DETROIT ANCHORAGE
Note widened footwalk and men placing wire seizings on strand. As a section is cut it is pushed off the footwalk to the "boneyard" below. Men on ground are ready to hook a half-dozen sections to boom falls for transfer to waiting trucks.

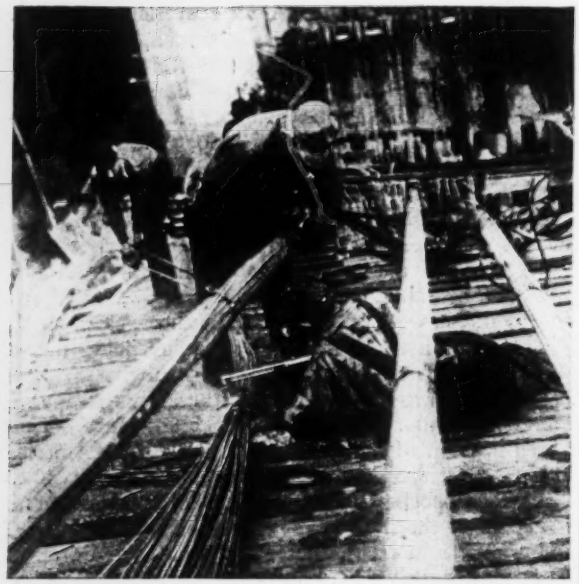


FIG. 14—CUTTING OPERATION AT DETROIT WEST ANCHORAGE
Note that the cut is being made between seizings about 6 in. apart.

its length, although still passing through the cable-bent and main tower saddles.

Flame-cutting was begun by cutting out a 12-ft. section, 6 ft. on either side of the main tower saddles. Rope hitches were placed around the upper ends of the backstays and of the main span strand thus formed and cables running to one of the drums of the two two-drum hoists installed on the top of the main tower held these strand sections from sliding down the footwalks. After the backstay strand was lifted manually from the cable-bent saddles, the strand was lying on the footwalk from anchorage to anchorage.

The work of flame-cutting the strand into 30-ft. lengths was carried out simultaneously in the main span and in the backstays. The first cut in the backstays was made about half way between the anchorage and the main tower. The top end of the bottom section thus formed was lashed to a sled which was held by cables running up the footwalk to the hoist drum on the top of the main tower. The second cut was made at the splay

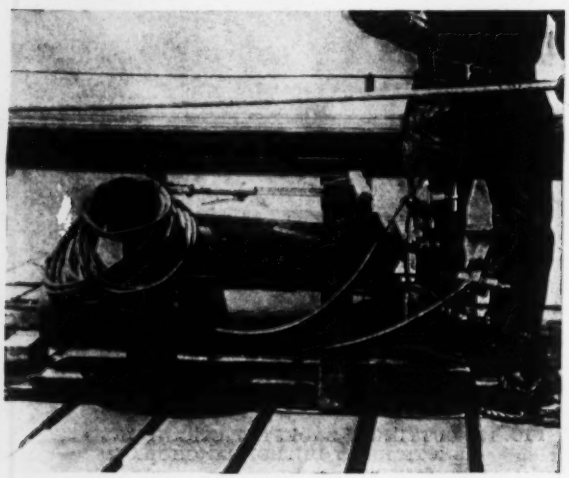


FIG. 15—FLAME-CUTTING OUTFIT USED ON MAIN SPAN AT DETROIT

point in the anchorage, removing the hairpin and permitting the bottom section of the backstay to lie free on the footwalk. The cutting gang was stationed near the bottom of the backstay where the footwalk had been widened to 20 ft. and severed 30-ft. lengths as the strand was permitted to slide past.

The necessary wire seizings were placed on the 30-ft. lengths while the cutting was in progress. As a cut was being made two seizings were applied by a workman about 4 to 6 in. apart 30 ft. up the strand; the next cut was made between the seizings. Also as the cutting was in progress two other men placed wire seizings at about 6-ft. intervals in the 30-ft. section being severed.

In cutting it was found necessary to move the torch back and forth, taking out a section of strand about $\frac{3}{4}$ in. wide. Attempts made to burn directly through the strand resulted in the wires fusing together as fast as the cutting progressed. On an average, it required about 50 seconds to cut through a strand. As a section was cut free it was pushed over the side of the footwalk to a "boneyard" below, from which trucks hauled it

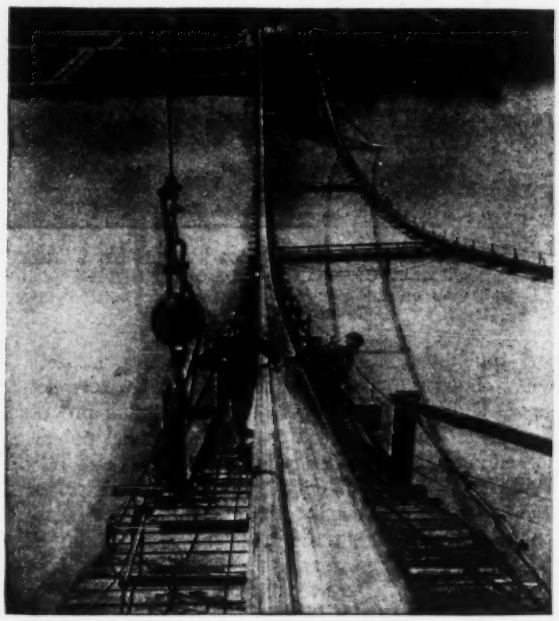


FIG. 16—TWO 30-FT. LENGTHS OF CABLE STRAND COMING UP FROM DETROIT MAIN SPAN ON SLED
Wire lowered at main tower to gondola cars in railroad yard below.

away. About two minutes was consumed in disposing of each 30-ft. section.

As the backstay strand became shorter, the friction between the strand and the footwalk became effective to such an extent that the strand would not slide down of its own weight. It was then necessary to attach a cable to its lower end, this cable running through two snatch-blocks to a hoist in a shed on the ground in front of the anchorage.

As soon as the lower half of the backstay was cut into 30-ft. lengths, the upper half was permitted to slide down the footwalk until in proper position for the cutting gang, when the operations described above were repeated.

On the main span the cutting gang was mobile, making its cuts at 30-ft. intervals marked along the footwalk. The cut sections in the main span were hauled up the footwalk two at a time on a pair of improvised wood sleds, as shown in Fig. 16, power being supplied by one

of the hoist drums on top of the tower. The derricks on the tower transferred the strands from the sleds to storage below. On the American side they were dropped directly into gondola cars, whereas on the Canadian side they were placed on the push cars of a construction railway and hauled to the anchorage, where they were transferred to trucks together with the strand sections cut from the Canadian backstays.

Eight cutting crews were employed in dismantling the cable. On the main span the oxygen and acetylene tanks of the cutting outfits were placed on sleds (Fig. 15), and each cutting crew consisted of a torch operator, a helper and a man with water to put out any fires.

The principal difficulty in the main span was occasioned by broken wires found at the suspender points. Some of these wires became loose and entangled, and others in one strand were so tightly squeezed to another strand that they had to be burned separately.

Administration—Dismantling operations on both structures were effected by the same organizations which had previously erected the materials. The structural steel was disassembled and taken down by the McClintic-Marshall Company, Pittsburgh, Pa., which was in each case the general contractor. The resupporting of the footbridges and the removal of the cables was carried out by the Keystone State Corporation, Philadelphia, Pa., subcontractor for supplying and erecting the cable wire. The methods and organization for the latter were developed by L. N. Gross, superintendent. W. G. Brenneke is resident engineer at Mount Hope for Robinson & Steinman, consulting engineers to the Mount Hope Bridge Company, and R. G. Cone is resident engineer at Detroit for Modjeski & Chase, consultants to the Detroit International Bridge Company.

Small Arch Dam Design Governed by Concrete Economy Need

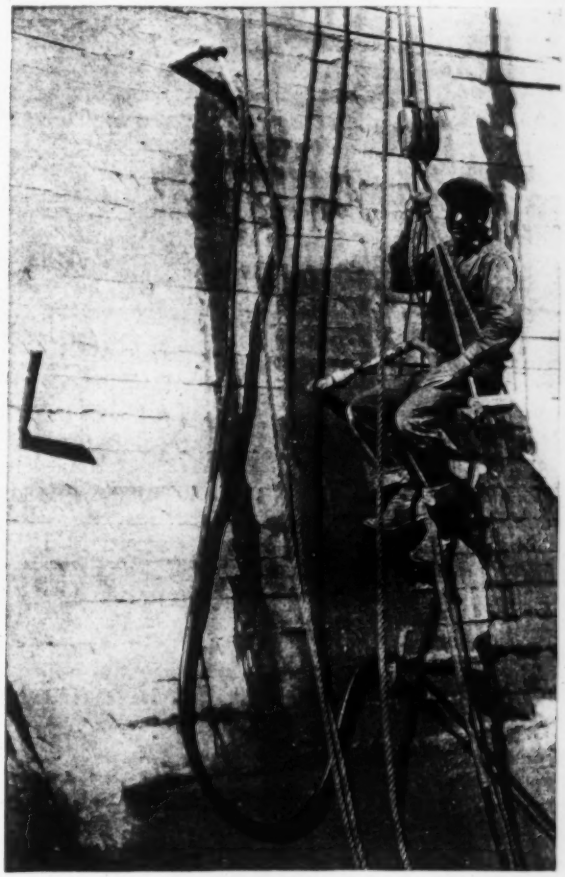
Arch Dam 110-Ft. High Contains Only 970 Cu.Yd. —Reinforced for Temperature, Doweled to Abutments and Grouted

By James Girand, Jr.
Civil Engineer, Phoenix, Ariz.

REFINEMENTS of design and construction that usually are found only in much larger structures were recently used in a small variable radium arch dam near Safford, Ariz., containing 970 cu.yd. of concrete. Limited funds available for increasing the water supply of the town required rigid concrete economy to be used in developing a 153-acre-ft. reservoir site. The narrow gorge, 110 ft. deep and about 130 ft. wide, on Frye Creek afforded a site favorable to an arch dam of thin section aided by bedrock of diorite exposed over the whole contact area that yielded diamond drill cores showing an average strength of about 21,000 lb. per sq.in.

The dam was designed according to the Cain formula, with maximum compressive stresses of 450 lb. per sq.in. Tension was eliminated by keeping the central angles at about 130 deg. for all elevations, which gave radii varying from 14 ft. at the base to 80 ft. near the top. The narrowness of the site and the design for favorable stresses to reduce the concrete yardage required that the lower arches be moved upstream slightly. Full advantage of this hollowing effect could not be taken, because of the necessity of retaining an old rubble dam which the contractor claimed as flood protection. The crown cross-section meeting these requirements has a thickness of 2 ft. at the top and 3 ft. near the base.

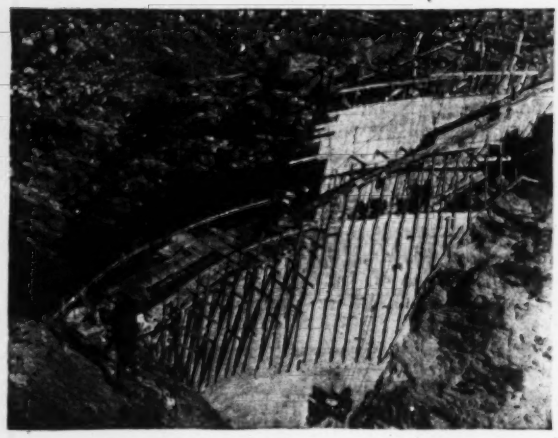
To provide a good seat for the arch without restricting free arch movement, the abutments were stepped to make the thrust normal to the rock surface and were cut away to eliminate contact with the arches on either face. Possible separation of the concrete from the rock at the abutment extrados was counteracted by placing 1-in. square steel dowels, 10 ft. long, on 2-ft. centers set in drill holes 30 to 40 in. deep and grouted. Reinforcing steel consisting of ½-in. square bars on 24-in. centers



GROUTING AT ABUTMENTS
Washing out holes with 250-lb. water pressure before applying grout.

both horizontally and vertically was placed on both faces of the dam to assist in preventing shrinkage cracks during setting and to relieve temperature stresses.

Sand and gravel aggregate, developed in the reservoir site, was put through a crushing and screening plant producing two sizes of aggregate—sand up to ⅜ in. and coarse aggregate with a 2½-in. maximum size. A typical mix was 1:2.0:3.8, and the average cement content for the job was 1.62 bbl. per cubic yard of concrete. The slump varied from 4 to 5 in. and the probable water-cement ratio was 6 gal. per sack. The crude plant arrangement made concrete control difficult and the water-cement ratio was controlled from the appearance of the concrete reaching the forms rather than by equipment at the mixer. With daily pours in 10-ft. lifts, the water in the concrete had a tendency to rise to the surface



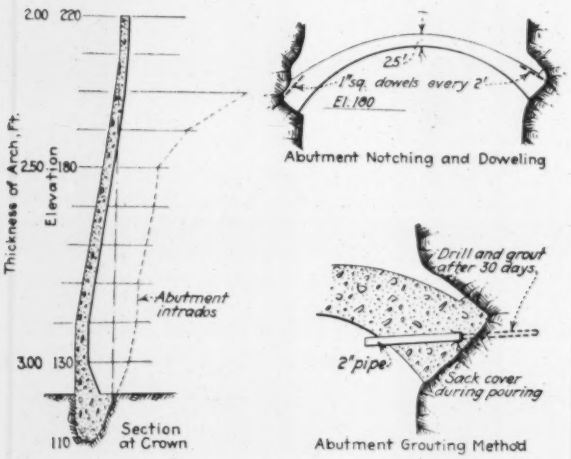
FORMWORK FOR SMALL ARCH DAM
Concrete from 2 to 3 ft. thick with expansion steel in both faces.

during the last of the pour; this situation was remedied quite successfully by running drier batches and distributing them in thin layers from wheelbarrows to absorb the excess water. The chuting system used in pouring the lower portion of the dam did not prove very successful in distributing the dry batches. The average breaking strength of test cylinders at 28 days was about 3,000 lb.

Forms were built in place where the radius of the arch was less than 50 ft., and panels were used on the longer radii. The forms were held by 2x6-in. posts cantilevered from the forms on the previous pour; these posts also carried the runways for the wheelbarrows.

Two openings from 2 to 3 ft. wide were left in each pour approximately at the quarter points in an effort to prevent cracking of the concrete during setting. The points were selected in the zone where no tension would develop in the arch, and reinforcing steel was cut and lapped in these openings. The openings also helped to overcome the initial compression in the steel due to shrinkage of the setting concrete. They were filled two or three days later with the next pour. Copper water stops 12 in. wide were placed at all construction joints.

About 50 grout holes with a maximum depth of 10 ft. were distributed along the entire contact of the dam. When grout was applied the rock proved tight except at a few seams. In addition to these grout holes, 2-in. pipes were embedded in the concrete near the abutments, as shown in the accompanying drawing, with the lower ends extending to within 6 in. of the rock. Thirty days after the concrete was poured holes were drilled through these pipes into the rock and grouted.



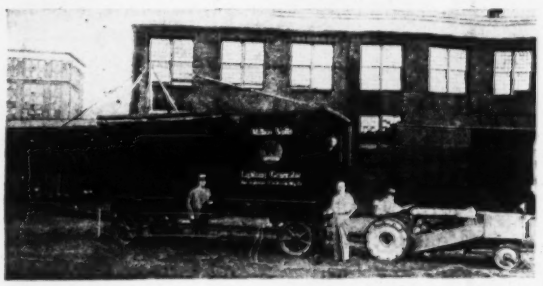
SECTION OF DAM AND DETAILS

The spillway has a capacity of 1,000 sec.-ft., allowing a discharge of 200 sec.-ft. per square mile of drainage area. This gives a capacity of double the maximum recorded flood from similar watersheds in Arizona and in addition the dam was designed to withstand an overtopping of 3 ft. on the crest. The upstream face of the dam was given two coats of asphaltic paint as a waterproofing. Outlet works consist of two 12-in. cast-iron pipes with gate valves.

The dam was built for the municipal water supply of Safford, Ariz., by the Arizona Edison Company, with J. E. Girand acting as consulting engineer. The design was prepared by F. F. DeMerse, and the writer was resident engineer.

Portable Lightning Generator for Testing Transmission Lines

EQUIPMENT for generating in excess of 1,000,000 volts of electricity has been assembled in portable form for testing transmission lines by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The electrical apparatus is housed in a four-wheel trailer, which is drawn by a tractor equipped with a low-voltage generator belt-driven by the tractor motor. Current is carried by cable to the trailer, charging to 75,000 volts each of fourteen units of five condensers connected in parallel. The high-voltage discharge is obtained by discharging all condensers in series, so that the sum of the individual voltages is the total voltage impressed on the transmission line. Other electrical equipment includes step-up transformers, high-voltage rectifying tubes, insulating transformers, instruments and control switches.



HIGH-VOLTAGE GENERATOR SET UP FOR OPERATION

To insure proper insulation against the extremely high voltages used, it is necessary to suspend the condensers and that part of the circuit carrying high voltage from a beam or bridge made of micarta and maple wood. When ready for operation, this bridge extends 14 ft. beyond the end of the tractor, being supported at the outer end by two 5-ft. wood strain insulators connected to a steel cable anchored at the front of the trailer. This bridge, 3½ ft. wide, carries a grooved track from which the condensers are hung. The total weight of the surge-generating equipment is 3 tons, and the gross weight of the trailer is 10½ tons. Five hours are required to assemble the apparatus from the traveling position.

Engineer District Organization for Mississippi Flood Protection

Territorial Set-Up Absolute Except for Dredging and Revetment Construction—Five Geographical Districts Organized on Basis of Centralized Planning and Decentralized Construction—Districts Report to Division Engineer, Who Reports to Chief of Engineers—Mississippi River Commission Is Advisory Board

By W. W. De Berard
Associate Editor, Engineering News-Record

CENTRALIZATION of planning and decentralization of execution are the basic principles of the district organizations which are building the flood-control works in the Mississippi Valley. These district organizations are subdivisions of the Western Division of the Army Engineers organization, which has eight divisions, each under a division engineer and all under the Chief of Engineers, U. S. A. In the Western Division are five districts—Rock Island, St. Louis, Memphis, Vicksburg and New Orleans River—each under a district engineer, who reports to the division engineer. The division engineer of the Western Division is also chairman of the Mississippi River Commission, which continues with duties that are essentially those of a consulting board on flood-control work.

Plan and Theory of District Organizations

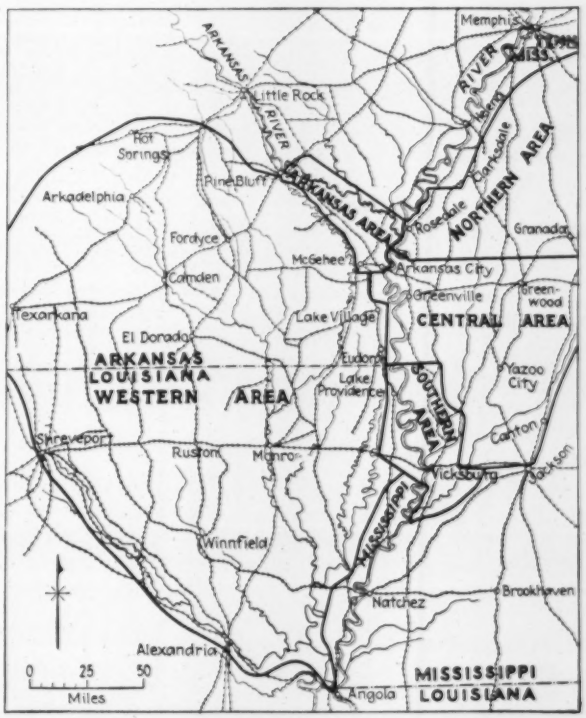
While the district organizations vary somewhat, in general each district is subdivided into geographical areas, with an area engineer in charge of all work in his territory. In its elements the district organization consists of a district engineer with a centralized staff for administration, general engineering and operation, which directs the decentralized activities of the area engineers. Formerly the work was split up functionally, with separate organizations for levee construction, revetment and dredging. The present organization contemplates that the several areas and the district office shall stand in the relation of field and staff in military organizations. The areas head up to the district engineers, the district engineers to the division engineer and the division engineer to the Chief of Engineers.

For war, single command is essential. For maximum efficiency in pushing construction projects, single command is likewise considered best. The inevitable delays of multiple control in the commission form of organization are replaced by the speedy decisions of one-man control. The influence of the responsible head, whose duty it is to determine policy and plan, can quickly be made felt through to the last individual in the field whose prime duty it is to execute. It gathers momentum as it is passed along and is highly sensitized by the utilization of all the modern methods of communication on a continuing 24-hour basis. Responsible heads are never off duty unless relieved and replaced by someone in authority to act. This ability to contact authority with the need quickly and surely is considered one of the greatest assets of the reorganized system.

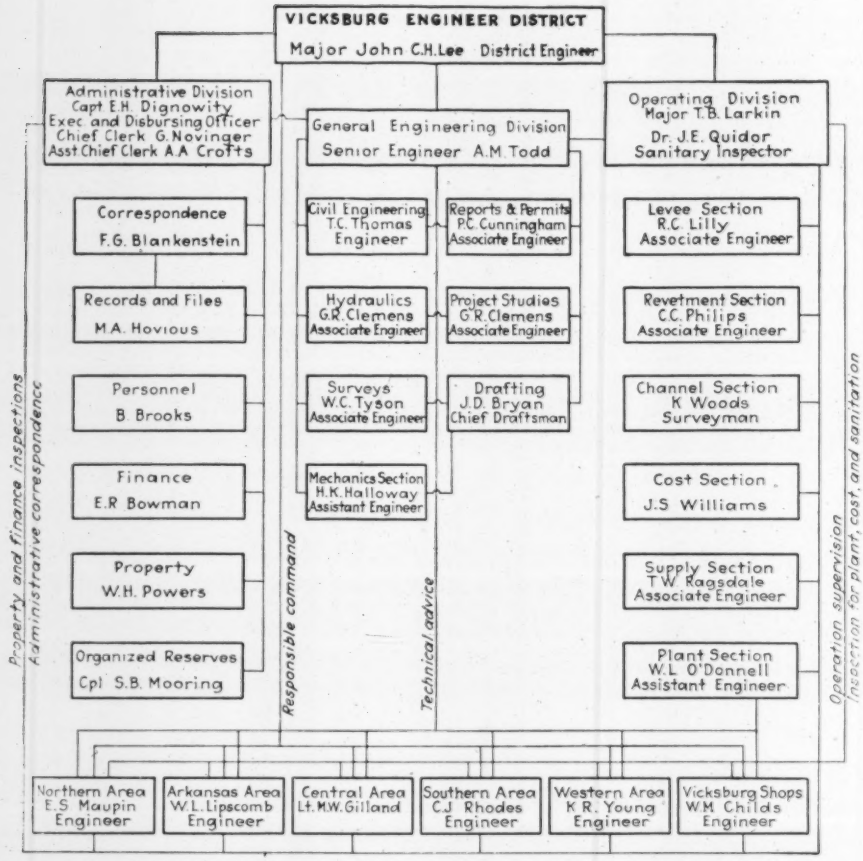
As an example of the details of the plan, the Vicksburg District is selected. How the staff and field function, how the personnel is recruited and maintained in a high state of efficiency, how the individual gets into, rises or falls in this army of construction will be discussed. It is important that this story be told in an engineering journal, inasmuch as Brig.-Gen. T. H. Jackson, division engineer, Western Division, has indicated that only highly trained engineers can get into executive positions of responsibility. Promotions are to be for merit, not for seniority. Both army and civilian engineers are included in the foregoing statements.

Administration and Personnel

In order that every man may know what his job is and how to handle it, district regulations have been compiled. Each classified employee gets a copy of these regulations, which he is expected to read and follow. The regulations are in loose-leaf form, as changes are continually being made to fit the changing situations. Details of the staff-and-field organization and of their relation and duties are given. This compilation of practice sets no higher standard as a whole than has prevailed in the past, but it gives laws, general orders, civil service rules and local regulations in simple language, with examples. It outlines briefly the division of the organization into three main branches—administration, general



TERRITORY COVERED BY THE FIVE VICKSBURG DISTRICT AREAS



ORGANIZATION CHART OF THE VICKSBURG ENGINEER DISTRICT

engineering and operation—and tells how they function one with another. It tells the employee also what he has to know about his individual job.

Administration—The accompanying organization chart shows the line of authority and interrelations of the various units. On every job there is one responsible boss. Unless otherwise directed, the senior employee present is held responsible.

Area engineers are held personally responsible for the conduct of operations and for the official actions of their subordinates. Their job is to conduct the work in the most economical and efficient manner possible in accordance with the plans and specifications and with the instructions and methods prescribed by the district engineer. They can make no changes, though they may recommend them if changes seem desirable. The general conduct of the work and the details of methods to be followed or of men or plant to be used, when not covered by instructions, are left to their discretion. All appearance of being identified with the financial interests of the contractor is required to be avoided. However, every effort is required to be made to help the contractor complete the work speedily. These positive directions are followed by many restrictive ones, such as not to obligate the United States in any way, not to give out information, not to perform service for private parties and not to enter into negotiations with outside agencies without the authority of the district engineer.

Personnel—All classified personnel is recruited through the civil service and the positions of senior engineer, associate engineer and superintendent, with salary ranges of from $3,800 to $5,000, are filled only by promotion.

General Jackson has inaugurated a new policy of getting new blood at the bottom by "scouting" at the engineering schools somewhat after the manner followed for some time past by the larger corporations. Where the R.O.T.C. has an engineer unit, the engineer officer in command has acted as scout, being duly instructed to encourage only those graduates who are best fitted by scholarship and ability to take responsibility to apply for positions in the districts. This year, of about 100 applicants at the Vicksburg office, fifteen were picked as "student engineers" for intensive training.

When the student engineers arrive in Vicksburg they report to an associate engineer of many years' experience in the work of the district, who gives them an intensive course of instruction.

First there is a two- to three-day conference course on the organization, the several field areas, the regulations and the standard instructions for levee and revetment inspectors. A thorough working knowledge is given of the obligations and duties and of the methods used and procedure followed in the execution of the work of the district.

Second, the student engineers are taken on a tour of the district to visit the area offices, where they meet the area engineer and his principal assistants, who explain the work and conduct the party to the different operations in progress. This gives the young graduates a general view of the scope of the work and engenders interest in the project as a whole.

Third, a written review is required to determine how much information has been retained and to get an insight into the student's powers of observation and his ability to express himself in writing.

The associate engineer instructor then reports to the district engineer on each student, giving an estimate of his capabilities and indicating in what place he might best fit. The student engineers then report to the area engineers as designated by the district engineer and are given responsible charge of some part of the field work. They are not put in the office at first. While they have taken civil service examinations as junior engineers, they usually are put on the payroll as inspectors at $150 per month, but are promoted as fast as they show that they can handle their work and take responsibility. It is from the ranks of these youngsters, a very few years from now, that General Jackson hopes to fill the better positions.

While this procedure may not sound encouraging for the older men already in the key positions, they must look forward to the less active places unless they can keep pace with the younger men. Seniority thus goes

by the board and technically educated brains, coupled with ability in leadership, become the criteria for advancement. In the Vicksburg District very few men have been taken in from the outside. The area engineers are with one exception (an army officer) civilian engineers heretofore holding key positions in the old functional organization. The administrative and operating divisions are headed by army officers, but the general engineering division is in charge of a senior engineer civilian, A. M. Todd, for many years the principal civilian assistant of the Vicksburg office.

Engineering Investigation and Planning

The general engineering division passes on all questions of engineering policy and on the general methods to be used in surveys and research work; it designs engineering structures of special importance and also the major items of plant or else specifies the principal features of such plant when procured from the trade, and it reviews studies and co-ordinates survey and research work carried out in the several areas.

The object of this centralization is principally to secure uniformity of method and co-ordination of work. Therefore this division drafts instructions for each area engineer as to all survey and research work assigned to that area. It prepares projects and sub-projects after conference with the area engineer. It inspects the work of the area engineer and advises with him as to all features not being executed satisfactorily. It acts in a consulting capacity to the district engineer, area engineer and the operations division.

In conformity with the military field-and-staff relation, as where the staff plan of campaign duly approved by the battalion commander is assigned to the company commanders for execution, so in the Vicksburg District organization the execution of work decided upon by the central office is delegated to the area engineers. While the duties of the general engineering division are functional and applicable to the entire district, those of the area engineer are on a strictly geographical basis.

Discharge measurements, sediment observations, gages, borings and saturation tests in levees are made by the area engineers subject to the advice of the general engineering division. The final reduction and co-ordination of data collected in the field is made by the general engineering division. This includes gage-rating curves, gage-relation curves and hydraulic studies. The numerous tests made this year on seepage, for example, were made by the area engineers, but the procedure was co-ordinated and the findings will be worked into useful form by the engineering division. The results will then be reviewed by the operating division to see whether the proposals of the engineers are practical under the conditions to be met in the various parts of the work under consideration.

Operating Division Directs Construction

The most important work in this district is the construction of levees, revetments and other flood-control works, but in addition the district must maintain the navigable channels of the Mississippi and tributaries, operate the locks and dams, maintain federally constructed revetments and carry on the surveys required by Congress.

The field area responsible for the execution and the operating division of the office are the agencies for prosecuting construction and which all other divisions and sections must serve. The area engineers form the "line" and the operating division, as the name indicates, is the "G-3" part of the staff. It is charged with construction planning, with the preparation of construction sub-projects and specifications, with purchase, supply and transportation, with cost keeping and with co-ordination and inspection of the field operations as carried out by the area engineers.

Whether the work is given to contractors or to the U. S. field force for execution, its completion within the specifications, the allotment and the time limit is the responsibility of the area engineer.

Levee Section—The levee section of the operating division is under the responsible charge of an associate engineer. It prepares estimates for the allotment of funds, prepares sub-projects, specifications for levee work and instructions for inspectors, checks all construction notes and estimates, makes all progress charts on contract and hired labor work, prepares all data for monthly and annual reports and inspects all levee construction work in progress at regular intervals.

Revetment Section—The same inspection methods hold for revetment construction, and the revetment section has similar duties, although all work is now done by hired labor under rigid specifications rewritten this year with the contractor in mind. As now organized, revetment forces are under the Central Area. When work is done in other areas the Central Area will operate as contractor, with inspections, accounts and expenditures handled accordingly.

Dredging and Channel Improvement—The district executive requires the area engineer to mark the channel, find the deepest water and if possible avoid any necessity of calling for dredging. If the channel requires opening, the district engineer makes request therefor on the Memphis District, which does all dredging, handling accounts and charging the Vicksburg District as would a contractor. While the dredge master is in the district he is responsible to the district engineer generally and specifically to the area engineer on whose stretch of the river he is working. This is because the district engineer is responsible for the channel.

Supplies—Purchase and supply are made functions of the operating division, with an associate engineer in charge. The mission of the supply section is to produce as promptly as possible just what is needed for the field and office forces and assure deliveries in time to facilitate and not hinder the work. At the same time due regard must be paid to laws and regulations as regards competition so as to maintain the efficiency and economy of mass buying.

Cost Keeping—Cost keeping is essential: (*a*) to learn whether work is being done economically; (*b*) to analyze the various component feature costs to determine efficiency of labor and plant; (*c*) to forecast the ultimate cost; (*d*) to compare costs of different jobs so as to enable the engineer to know the cause of differences; (*e*) to enable the engineer to make a comparison with estimates; (*f*) to make comparison with similar work previously done; (*g*) to help in making future estimates; (*h*) to awaken a spirit of competition among heads of different working parties on similar work. To learn just how far to go in this line, a report has been requested on the efficiency and economies of cost keeping itself.

Sanitation and Hygiene—An assistant medical officer and sanitary inspector makes periodical visits to all area offices, locks and dams, of which there are seven, and to all day-labor camps for the purpose of co-operating with all concerned in sanitary and health matters. Regu-

lations as to medical attention are based on the principle that it is to be furnished as a part of the contract of employment to employees in the field at isolated localities because of (*a*) the difficulty and expense connected with the employee furnishing his own medical treatment; (*b*) the comparatively unhealthful conditions surrounding his employment in such localities, and (*c*) as an added inducement for the retention of employees required to work in such localities.

The usual camp regulations are made as to water supply, food, screening sewerage and plumbing, garbage, clean quarters and personal hygiene.

Obligations and Privileges of the Service

The quotation given below indicates the spirit which it has been the endeavor of the district engineer to instill into his subordinates:

> Opportunity for promotion in the work of this great flood-control project for the Mississippi River and its tributaries is unusually favorable, but only those men and women who can conform to our high standard of accomplishment and conduct need expect to be given positions of important responsibility. What you receive in further responsibility and compensation will be based on what you give to the United States and how you safeguard the interest of the government. It is your privilege at any time to obtain counsel, the interpretation of instructions or redress of grievances from your immediate superior, from your area engineer in the field, from the district engineer or higher authority. So far as is humanly possible, you will get a square deal in this Vicksburg District. But remember that in cases of doubt, the interests of the United States, the successful prosecution of our work, the harmonious functioning of our organization must govern, and not the selfish interests of any individual. If you can adjust yourself to these conditions and render faithful, competent service you will succeed—if not, you should look elsewhere for the future.

Directing Personnel

The Vicksburg District has been for the last three years under the charge of John C. H. Lee, major, Corps of Engineers, U. S. Army. His régime will be up next year and his successor, Major T. B. Larkin, will have been on the job, at present as head of the operating division, for a year before Major Lee's transfer. It is General Jackson's idea that the rotation procedure of the army is for the best interests of the government. If kept long in one place, an officer cannot help but become too localized in thought. Further, vigorous men burn themselves out in the enervating climates to which they are subjected in the three lower districts. New men are expected to bring in new ideas, and there is always enough of the non-changing personnel to keep the organization stable. The new policy of bringing in the successor some time before he assumes office will be of decided advantage to him and the job.

Funds are handled by a disbursing officer, Capt. E. D. Dignowity, who performs this service as head of the administrative division in accordance with well-established routine of the Engineering Department policy. The important Central Area includes the development of revetment mat and of revetment for the whole district. It is in charge of Lieut. Morris W. Gilland.

Extra Stories Added to Steel Frame Building

Use of Lightweight Floor and Fireproofing Makes Possible 11½ Instead of Nine Additional Stories as Originally Planned For

By James G. Allen

District Engineer, American Institute of Steel Construction, Inc., Birmingham, Ala.

BY CAREFUL attention to design, incorporating therein special floor construction and lightweight tile fireproofing, the three-story steel-frame building of the Protective Life Insurance Company in Birmingham, Ala., has been increased in height to 14½ stories instead of to twelve, as originally planned. The foundations and the framework of the building were designed with the intention of adding at some future date nine stories above the three original ones. Modern practice in steel design, coupled with the use of the special floor and tile construction to minimize dead load, permitted 11½ added stories, including a high-ceiling auditorium on the fourteenth floor.

An engineering investigation of the original steel framework was made to determine how much the saving in weight suggested above would permit the building to be increased in height. Clay tile fireproofing for the columns was estimated to average approximately 90 lb. per linear foot of column, whereas concrete fireproofing for equivalent protection was estimated at approximately twice as much. With the columns averaging 175 ft. in height, the clay tile represented approximately 15,000 lb. less dead load per column, or the equivalent of 1 sq.in. in column cross-sectional area. With columns of about 25 sq.in., the use of the modern 18,000-lb. unit stress instead of the old 16,000-lb. unit stress represented a gain of about 3 sq.in. in column sectional area. In addition, the saving in floor panel dead loads represented about 15,000 lb. per column, again the equivalent of 1 sq.in. additional cross-sectional area in each column. The total of 5 sq.in. "bonus" per column gave each column

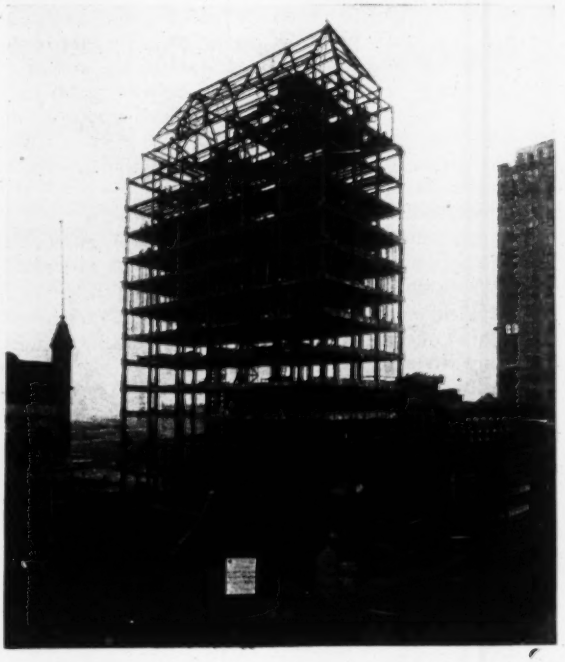


FIG. 1—COMPLETED FRAME OF PROTECTIVE LIFE BUILDING, BIRMINGHAM
Increased from three to 14½ stories.

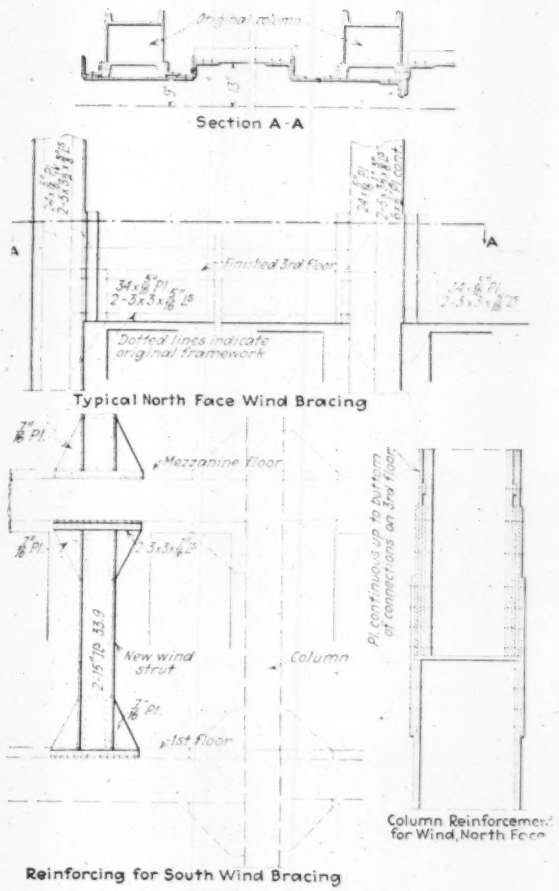


FIG. 2—TYPICAL DETAILS OF REINFORCING FOR WIND IN LOWER STORIES

an additional capacity of about 75,000 lb. With an average live- and dead-load reaction per column of 30,000 lb. at each story, the columns were found to be good for 2½ stories in addition to those contemplated when provision for extension was made in the original structure.

These added stories gave a building 175 ft. in average height above grade, as against the total height of 130 ft. originally planned. The building is L-shape in plan, approximately 50 ft. wide across the north front, 40 ft. wide across the south or rear end, and 100 ft. deep. With the added height the vertical to horizontal ratio on the north end is 3.5 : 1, while on the south it is 4.4 : 1. On the east and west faces it is 1.75 : 1. In the long dimension with seven lines of columns and a ratio of less than 2 : 1 the wind stresses are unimportant. However, this is not true in the east and west direction, where there are in the wide end four lines of columns and in the narrow end only three. The concrete floor system and primary floor members are capable of transmitting wind stresses to the end bents. Accordingly the wind stresses are all taken in these bents.

The exposed area increase is 35 per cent, but being all added at the top of the structure, the increased wind moment through the first story columns is approximately 80 per cent greater than that for which they had been designed. This necessitated reinforcing the original end bent columns. In the north face, unobstructed store windows are provided the full first-story height. Here strengthening was accomplished by adding plates and angles to the original columns. In the south wind bent it was found expedient to insert supplementary vertical struts between the wind girders which were in place at the grade level, mezzanine floor level and second-, third- and fourth-story levels. These struts are not designed as load-carrying members but as moment-resisting sections and are composed of double channels with gusset plates top and bottom of sufficient size to resist the moments developed in excess of those taken by the original columns.

The floor in general is a concrete slab-and-joist system with 2-in. slabs and joists 5 in. wide by 6 in. deep under the slab on 29-in. centers. Starting 2 ft. from the supports, the joists, remaining of constant depth, are splayed to a width of 8 in. at the support. This type of construction was found to be lighter than the several tile alternatives suggested. It was also found to be the least expensive as shown by alternative bids. The chief difference between the floor system used and the usual tin pan system is in the joist spacing.

The architects were Warren, Knight & Davis and the structural engineers were W. C. Spiker & Company, both of Birmingham. New steelwork amounting to 375 tons was erected by the James H. Elkins Construction Company, Birmingham, in 28 days.

Defective Building Practice in Wisconsin

A WARNING as to defects in building design and construction is contained in a quarterly report of the industrial commission division, Wisconsin State Department of Engineering, an abstract of which is given below:

Wood Roof Trusses—Such trusses are still extensively used in buildings of moderate height in Wisconsin. Under the building code there is no restriction in the use of wood, except where incombustible or fireproof construction is required. Steel is not considered any more fire resistive than wood under present building regulations. Many builders prefer to use wood trusses for wide roof spans, as in public garages, claiming that they cost less than steel trusses. But it has been found that for equivalent design the difference in cost is negligible and that any saving for wood is due to an inferior truss. Such inferior wood trusses, many erected prior to the adoption of the building code, are frequently discovered by inspections. As many of these trusses are hidden from view, a roof truss inspection is a difficult job. Recently some inaccessible wooden roof trusses supporting the roof of a church were not discovered to have failed until cracks appeared in the plastered ceiling. Investigation revealed some ridiculous construction details, one of which was the beveling of the arch-shaped top chord to fit on top of the bottom chord, and the top chord was simply spiked to the bottom chord. The building code requirements are to be revised to provide against inferior wood roof truss construction without unnecessarily restricting the use of timber for such work.

Competence of Builders—While the status of engineering and contracting firms which erect important structures is improving, the builder of small structures throughout the state appears to be less competent than in years past. The larger firms realize their responsibility and employ competent engineers. The small builder, however, very often is not familiar with any of the principles of good building practice or design. Many garage buildings, store buildings, small apartments and other public and commercial buildings are erected by men of this latter type. But improper and unsafe construction is found even in the case of buildings where complete plans and specifications have been prepared by a competent designer. The building code requires plans and specifications to be prepared by a competent designer in accordance with principles of good engineering and building practice, and also requires conformance with the plans and specifications on the part of the builder through competent supervision. Many errors and willful violations of the provisions of plans, specifications and good building practice are eliminated by the inspection of the representative of the industrial commission, but there is need for some greater incentive for improvement on the part of the ordinary builder.

Engineering in Mecklenburg County, North Carolina

Improvement of 600-Mile Road System Begun in 1921 Is Virtually Sole Task of County Engineering Force—Department Personnel Continues for Eight Years

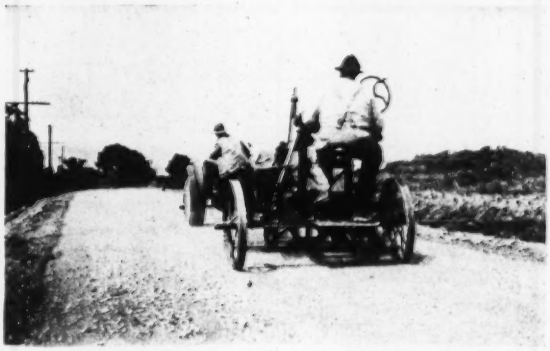
MECKLENBURG COUNTY, North Carolina, has an area of more than 550 square miles in the fertile, rolling Piedmont section of the state. It occupies a position about midway in the industrial section of the two Carolinas which has shown such phenomenal growth in recent years. The extreme length of the county from north to south is 35 miles; its width from east to west is 24 miles. The city of Charlotte, with a population of about 110,000, which has doubled in ten years, lies near the center of the county. Numerous mill villages and small communities are scattered through the rest of the county. Local traffic, therefore, is considerable, and there is a heavy volume of through travel.—EDITOR.

COUNTY engineering in Mecklenburg County, North Carolina, is virtually confined to road-building. In eight years 600 miles of highway has been improved and policies and procedure have been standardized and refined by a close-working organization of men long in office. Specifically a notably effective convict labor system has been worked out, and economic type of creosoted-timber, ballasted-floor bridge has been developed and a method of surfacing top-soil roads with stone so as to reduce corrugation has been devised.

All roadwork is directed by a highway commission which began to function April 4, 1921, at the time of the movement which created the state highway commission and gave North Carolina its exceptional system of state roads. The Mecklenburg commission was created by an act of the legislature, which also designated its three members. These men have served continuously since, and with them have served from the beginning L. McG. Ross as engineer, H. C. Little, in charge of road and bridge construction, and L. E. Connell, supervisor of maintenance. This continuity of service extends all the way down the line—six of the eight original district maintenance superintendents are still on the job.

When the state commission started operations in 1921, it took over approximately 75 miles of the highways of Mecklenburg County. This mileage has since been hard-surfaced. All of the remaining highways, totaling about 625 miles, were about the same time placed under the authority of the county highway commission. Little of this mileage was then improved in a way that was satisfactory for modern traffic.

DISTRIBUTING CRUSHED STONE FOR TOP DRESSING SAND-CLAY ROAD

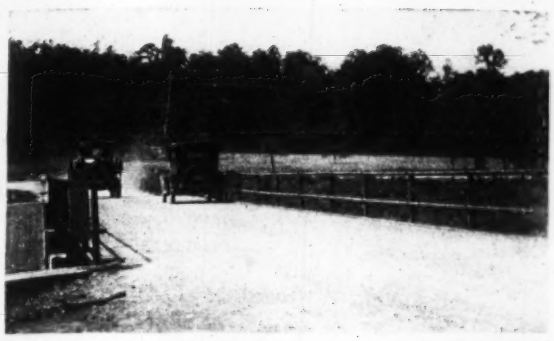


KEEPING CRUSHED STONE TOP DRESSING EVENLY SPREAD WITH BLADE MACHINE
Note good shoulders and well-maintained ditch.

In the eight years during which the commission has operated it has expended $4,871,578. Of this total $2,075,000 was raised in the beginning from the proceeds of bond issues. Since then the funds have all been obtained from direct taxation on all assessed valuation in the county. In other words, the basis of a system of county roads was secured from bonds, and this system has since been maintained, improved and expanded out of current funds.

Up to June 30, 1928, there had been devoted directly to construction and maintenance 94.123 per cent of all the commission has had turned over to it to spend. On Jan. 1, 1929, there had been obtained 39.35 miles of two-way hard surface, 51.4 miles of one-way hard surface, 272.07 miles of 30-ft. improved roadway surface, 10 miles of macadam and 99.65 miles that are only partly improved, with but a small mileage that is merely maintained. In the same time there have been provided various permanent improvements, such as convict camps, equipment shops, rock quarrying and crushing plants and other facilities that would be considered fixed assets in a private business. The commission further has a large fleet of construction and maintenance equipment that has largely been charged off to current expense.

An idea of the effectiveness of the organization may be obtained from the fact that administration expenses during these eight years have been only 2.7 per cent of the total spent. To these expenses also have been charged attorney fees and interest on interim loans pending the delivery of current funds to the commission. This item further includes the entire cost of office maintenance and salaries. To engineering during these eight years there has been charged salaries and expenses, warehouse expense, certain labor supervision, general repairs, state gasoline tax and work done for other



SMOOTH ROADWAY ON BALLASTED DECK BRIDGE

county boards. Taking into account all of these, engineering has cost only 3.173 per cent of the total expenditures.

No unusual or extraordinary engineering has been required in the roads built by the commission. A standard 30-ft. minimum roadway has been adopted, with a 60-ft. standard right-of-way. Grades and curves are kept within good practice, it being kept in mind that many of the roads of the county will eventually become through routes or part of the state system. Recently the state took over approximately 35 miles of the county system.

The policy of stage construction has been followed from the beginning. Earth-surfaced roads have been graded and maintained so the investment in them could be utilized when a higher-type surface became desirable. Ditches have been dug and waterways built with this same idea of their future availability in mind.

Special attention has been given to drainage, and particularly to the quick and effective removal of local, casual water. To this end, ample ditches, well maintained, and sufficient waterways have been stressed. This policy has reduced maintenance costs, and traffic has been handled on lower types of surfacing than would have otherwise been required.

Comparatively few bridges of any size have been required. On most of its bridges the engineer has used a ballasted-deck floor such as is common in railroad practice. The longer spans have concrete piers and abutments in most cases; elsewhere creosoted-timber bents on concrete footings with creosoted timber headwalls have been used.

One of the accompanying views shows an overhead crossing of the Norfolk Southern Railroad. This structure was built at a total cost of $3,292, with creosoted timber at $50 per thousand at a local plant. The details of the structure are given in an accompanying drawing. Two other views give an idea of the results obtained with the ballasted-deck floor construction used. From one of these views an idea may be obtained of the effective manner in which humps have been avoided in the road surfacing where the ends of the bridge floor join the approach fills. This feature is notable in all of the structures built by the commission.

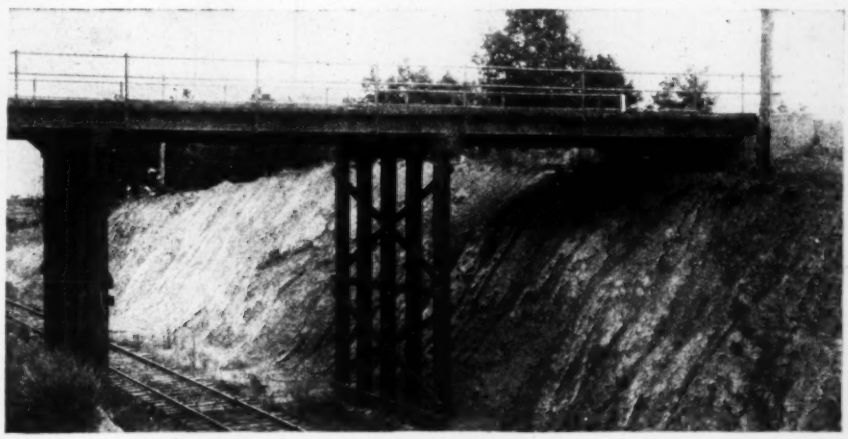
Construction has been done by convict chain gangs with the exception of about 30 miles of concrete base built by contract. Experience has shown that with labor of this sort the best results are obtained on grading, concrete structures, rock crushing and quarrying. It has proved impracticable on maintenance work, due largely to the expense of guarding when the men are separated into small groups.

STANDARD CONVICT CAMP CELL HOUSE AND GUARDS' QUARTERS

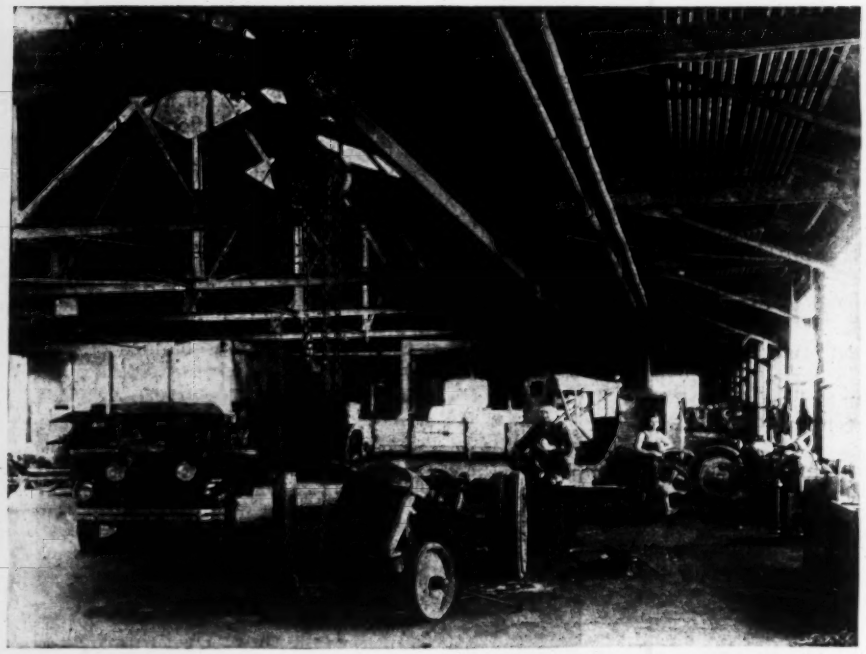
Good housing and good food have been two of the main features that have contributed to success. Four permanent camp sites have been established, each located so as to serve approximately one-quarter of the county highway system. Well-built cell and guard houses have been adopted; water and sewerage systems are provided, and all modern conveniences are installed. The accompanying exterior view of one of these camp houses gives an idea of their character.

Accumulated records of the cost of handling convict labor have been kept since operations began. On the basis of 365 days a year, these show an average cost per convict per day of $2.30. This embraces everything chargeable to this service, including overhead, guarding, housing, food, animal feed, truck maintenance, transportation and the maintenance of all camp facilities. On the basis of an average of 230 days worked each year, the eight years' records show an average cost of $3.65 per convict per day worked. The commission relieves the county of all expense of maintaining convicts.

Two rock quarrying and crushing plants have been installed and are operated by the road department. They are located so that each serves



AN ECONOMICAL OVERHEAD CROSSING OF CREOSOTED TIMBER



INTERIOR OF SHOP FOR MAINTAINING EQUIPMENT

about half the county road system. One is an older installation which has been in service for some time. The second, which has recently been placed in use, is quite modern. It includes a 14x26 jaw crusher and a cone crusher, with complete screening and elevating equipment. The entire plant is motor driven, using purchased power.

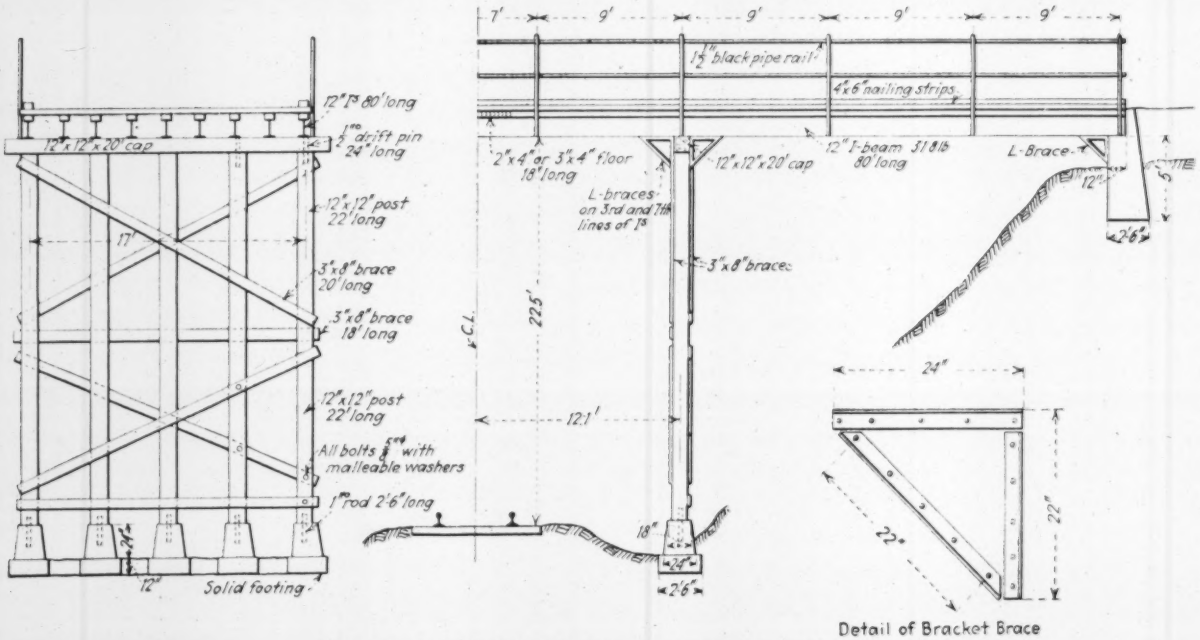
The superintendent of each of the eight districts into which the county is divided is responsible for the maintenance of the mileage in his district. Extraordinary maintenance is handled by convict gangs, with incidental employment of some free labor.

Each superintendent has in his district three or four maintenance-unit outfits, each in charge of a foreman. These units include a tractor equipped with rubber tires, a 7-ft. blade grader, a drag, wheelbarrows and hand tools. Enough laborers are attached to each outfit to do work beyond the range of the machines. Each maintenance unit is housed at or near the home of the foreman in charge of it. At this point a galvanized sheet-iron shed large enough to contain all of the equipment is provided.

With the equipment available the entire system can be machined in a three-day period. Since a large percentage of the mileage of the system is of sand-clay, top-soil and the higher earth types, this quick coverage after a wet spell is specially important. All units are, however, in service a large part of the time, being laid up usually only in weather that will not permit them to be worked to advantage.

All automotive equipment is maintained and important repairs to other plant and equipment are made in a substantial shop owned and operated by the department. With 33 tractors, several trucks and automobiles and various types of road machines in service, this shop has proved a great economy.

An idea of the thoroughness with which repairs are handled is indicated by the method used in keeping in condition the tractors, which have had from five to six years of hard service. A cylinder block in good repair is kept on hand at the shop at all times. When the engine of a tractor gets out of order the tractor is sent to the shop and a rebuilt or a new block is sub-



DETAILS OF CREOSOTED TIMBER OVERHEAD CROSSING

stituted for the old one. In this way the tractor is out of commission for a minimum time. Repairs on other equipment are similarly handled.

Since a large portion of the system has sand-clay and top-soil surfacing, the problem of corrugation has been serious. It has been solved in large measure by the use of a light top dressing of crushed stone. This practically eliminates corrugations and cross-ruts on roads carrying up to 350 motor vehicles per day.

Round gravel will not answer for this top dressing. Crushed stone or crushed gravel that will all pass a ¾-in. ring is most satisfactory. It is best to have a material that does not contain very much dust when reduced to this size. A stone or gravel that breaks with sharp angular edges also is preferable. The depth placed on the road varies according to the volume of the traffic and the condition of the surface. In no case is more than 1½ in. necessary. It also is better to apply two light coats at intervals than to put all of the crushed material on at one time if the depth applied exceeds ¾ in.

No special work is done on the road surface other than the regular maintenance, prior to applying the top dressing. The crushed material is delivered from the quarry directly to the road in horse dump wagons in pairs by a tractor. One man drives the tractor, while a second rides the wagons to handle the dumping arrangement. The stone is placed evenly in a windrow along the road with the tractor in motion. The two men then spread it to the desired thickness with hand shovels, no gang being kept at the point where the stone is distributed.

Good distribution is obtained in this rather simple manner at nominal cost. The stone is hauled as far as 10 miles from the crushers. It is the plan, however, to keep the wagon haul within 6 miles. With the crusher plants now in service, this can be done on most of the main roads, trucks being used for longer distances.

No rolling of the dressed surface is done, the traffic being allowed to work the stone into the sand-clay or top-soil. A blade grader drawn by a tractor is run rather constantly over the newly dressed surface to keep the material evenly distributed until it is all bedded in the surfacing. The crews acquire skill in handling these operations until the final surface has the appearance of a deep gravel or crushed stone road. There is the advantage over macadam, however, that the crushed material once bedded in the sand-clay or top-soil stays in place remarkably well. As the local expression is, the material sets, although there is, of course, no such set as occurs in concrete or in a limestone macadam, but merely a setting in place.

Tests Show Color Affects Surface Temperature of Concrete Dam

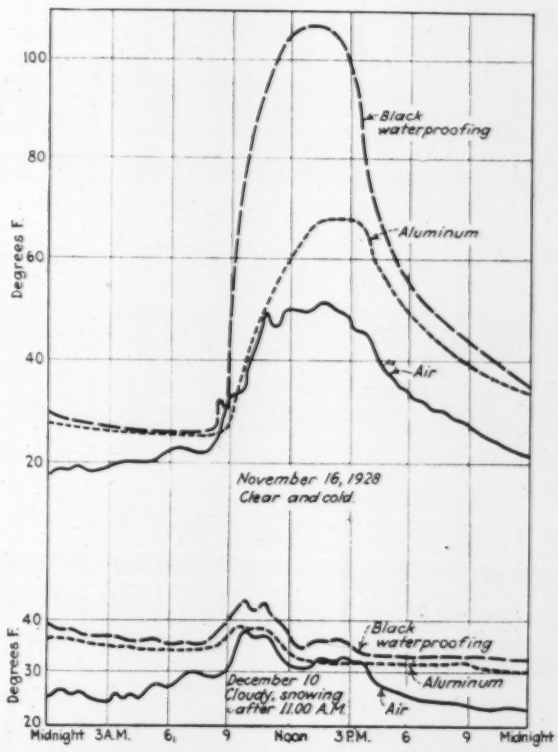
RECENT tests at a large multiple-arch dam indicate that the daily temperature variations in the surface concrete as compared with atmospheric temperature are greatly affected by the color of the surface. The tests were made at the Florence Lake dam under the direction of F. J. Mills, civil engineer, Southern California Edison Company, and chairman of the Pacific Coast Electrical Association's committee on the use of concrete in hydraulic structures. The results of the tests as placed before the association are described in the following:

At the time of construction, the upper face of Florence Lake dam was covered with two coats of black waterproof compound to reduce leakage. The flaking off of this coating, particularly during the winter when temperatures as low as 20 deg. below zero have been recorded, resulted in the investigation of temperature changes as a possible cause.

The method used in the tests consisted of placing three recording thermometers at the dam in the following positions: Thermometer No. 1 was placed in a shallow channel cut in the face of one of the arches, grouted over with cement and covered with the black waterproofing compound, so as to duplicate the general conditions on the face of the dam. Thermometer No. 2 was placed in the same manner on an adjacent arch, except that in this case the surface for an area 10 ft. square around the thermometer was painted with a coat of aluminum paint over the black coating. Thermometer No. 3 was installed to record the air temperatures.

The accompanying curves show the records of these three thermometers for two characteristic days. The temperature fluctuations in the surface of the dam, particularly on sunny days, are extreme when compared with the variations of the air temperature. Between the hours of 9 a.m. and 1 p.m. the temperature rise in the concrete under the black surface exceeds by 2½ times the corresponding rise in atmospheric temperature. It is believed that the very great difference in temperatures recorded by thermometers 1 and 2 is due entirely to the difference in color of the protective coating, as all other factors are the same for both installations.

Owing to the difficulty of entirely removing all traces of waterproofing compound over an area suitable for test, it was impracticable to obtain the relative change in temperature for a bare concrete surface. The records and studies are being continued by the committee with the cooperation of the Southern California Edison Company.



EFFECT OF COLOR ON SURFACE TEMPERATURES ON A CONCRETE DAM

Notes on German Water-Works From a Far-Eastern Viewpoint

General Summary of Practice as to Success of Supply Treatment and Pumping, With Details on These and Other Features of Works of Köln, Berlin, Charlottenburg and Hamburg

By H. Stringer

Deputy Engineer-in-Chief and Manager
Shanghai Water Company, Shanghai

Problems connected with the water-works of Shanghai, China, led the private owners to send their deputy engineer-manager to Germany on a tour of inspection. Although local conditions were such as to make the trip less productive of suggestions than was hoped for, the author of the following article presents both general observations and data regarding specific plants that promise to be of interest to water engineers and officials the world over. —Editor.

Shanghai is in the unenviable position of having one of the most turbid and probably the most polluted sources of water supply in the world. It takes water from the Huangpu River, which has an average turbidity of 223 parts per million and an average bacterial content of 80,635 per cubic centimeter at 20 deg. C. and 50,072 per cubic centimeter at 37 deg. C.

The demand for water has increased phenomenally in recent years. In 1907 the per capita consumption stood at 13 gal. per head and today it is 29 gal. for a population of about 900,000. Maximum hourly demand, which, of course, controls capital expenditure, was 2,970,000 gal. in 1928 and is estimated to increase at a yearly rate of at least 150,000 gal. [Presumably Imperial gallons are used throughout this article; add one-fifth to convert into U. S. gallons.—Editor.]

The standard of purification demanded is the production of a water rather purer than that supplied by the Metropolitan Water Board and the U. S. Public Health standard.

It is thus obvious that the Shanghai water-works, in order to cope with its great rate of expansion and complicated problems of purification, needs to be kept abreast of all that is most modern in purification and pumping practice. American practice has been fully studied and profited by, but little was known of Continental water-works methods. To meet a desire for such information Germany was selected for an inspection in the summer of 1928. The inspection was extremely interesting from a general water-works viewpoint, but was disappointing from the viewpoint of one in search of new ideas on water purification. This implies no reflection on German methods; it merely indicates that German problems are not Shanghai's.

Conditions in Northern Germany Unfavorable to River Supplies

The whole of northern Germany, east of the Rhine, is a vast plain of waterlogged sand, the rest level of this area being from 7 to 8 m. (23 to 26 ft.) below ground. This, therefore, presents an inexhaustible source of supply, the water being apparently sterile at a depth of 20 to 30 m. (66 to 100 ft.) if the collecting area chosen is rural or suburban. The natural result on account of its obvious economy has been the development of methods of water supply which utilize this source.

This subsurface water is raised by the Hof system, which consists of a large horizontal main at a depth of about 15 m. (50 ft.) into which vertical collectors of copper pipes of a diameter of about 150 mm. (6 in.) are tapped, running down to the selected sterile water-bearing strata. These small pipes are spaced from 10 to 20 m. (33 to 66.5 ft.) apart and are slotted for a length of at least 10 ft. They are lowered into lined auger bore holes. The collecting main—housed in a tunnel—delivers water to a sealed well, from which it is pumped to filters, if these are necessary, thence to a reservoir and so re-pumped to the supply mains.

The water from this source being sterile, filtration treatment is necessary only to eliminate iron and manganese. Aeration is adopted for oxidation purposes and subsequent filtration over slow sand beds is usual, though I found rapid filters installed in at least the Charlottenburg plant in Berlin.

It will, therefore, be seen that conditions have not been favorable for the utilization of a river supply. In fact, in the case of both Berlin and Hamburg, where the rivers are used, there is an increasing tendency to develop subsurface sources of supply at the expense of river water. As a natural consequence the development of filtration methods has not received very great attention.

Pumping Stations

The effect on pumping design of the adoption of the Hof system has been to develop the vertical plunger type pump for lifting water into reservoirs, whence it is pumped into the pressure mains by a similar type of pump or, in the most recent work, by centrifugal pumps either electric or diesel driven.

In contrast with British, current German main pumping practice evidently leans to the centrifugal pump with turbine and oil drive. In support of this opinion is the report of the Hamburg water-works engineer, which mentions the enormous saving in space as a result of the adoption of a turbine drive. Saving in personnel was particularly impressive at the Wallensee pumping station at Berlin, where steam power had been entirely displaced by oil and electric drive.

With regard to current German boiler practice, boilers of the Babcock type are now universal, with pressures ranging from 13 up to 30 atmospheres (190 to 440 lb. per sq.in.). The boilers are equipped with chain-grate stokers, automatic coal feed, overhead bunkers and conveyors. Recording instruments for steam and flue gas temperatures, CO_2, CO and H draft, which are intelligible to ordinary firemen, are to be found in every boiler room.

Buildings are everywhere extremely spacious, and

allow for large extensions. Engine houses are tiled and beautifully kept, and the precincts of all works are well cared for.

The blank spaces left in a questionnaire submitted to each works visited showed a curious vagueness about the maximum hourly consumption, which can be deduced only from an equally vague figure as to reserve pumping capacity. Waste detection receives no attention, for the obviously inadequate reason that metering is universal throughout Germany. There is no visible waste-prevention staff. The high per capita consumption in spite of general metering is to be observed, but Berlin in particular has a very hot, dry summer. In every case pressures were sufficient to reach the highest buildings.

Practice as to stand-by supply varied, as well as that relating to private fire hydrants. Bacterial examination was usual only in cases of river supply. Chlorination was rarely used for subsurface water.

Köln and Berlin Water-Works

The water supply of Köln is subsurface and the gathering ground is situated in suburban surroundings about 8 km. (5 miles) from the center of the thirteen stations supplying greater Berlin. It is the only one partly employing river water, the source of supply being a large lake which is fed by the River Spree. The works are situated about 20 km. (12.5 miles) from the center of the city.

These works are designed to take care of a maximum daily demand of 270,000 cu.m. (61,000,000 gal.), or 48 per cent of the 560,000 cu.m. (125,000,000 gal.) required for an estimated population of 3,000,000.

The lake water is very clear, slow sand filtration sufficing. Chlorination is used in the summer only, for the lake water. The subsurface water has the usual iron group impurities.

The raw-water pumps for both the subsurface and the lake water call for no particular comment. As usual, they were of the vertical compound type, but they had recently been reconstructed to admit of the higher pressures and increased power given by a new battery of Babcock boilers, working at a pressure of 236 lb., fitted with economizer and superheaters.

Each of the 34 filters has an area of 2,400 sq.m. (26,000 sq.ft.), giving a total area of 885,000 sq.ft., or 20.3 acres.

COMPARATIVE WATER-WORKS STATISTICS OF KÖLN, CHARLOTTENBURG AND HAMBURG, GERMANY

		Daily Water Consumption						Details of Pipe Distribution System†							
		Daily Per Capita, Liters		Maximum Liters 1 =	Total, M.G.*	Average Liters 1 =	Total M.G.*	Diameter of Mains M.	Diameter of Mains In.	Maximum Pressure, Lb. Per Sq.In.	Maximum Velocity Per Sec. M.	Maximum Velocity Per Sec. Ft.	Hydrant Spacing M.	Hydrant Spacing Ft.
	Population		Gal.*	1,000		1,000								
Köln	650,000	164	36	120	27	105	23.5	1.2 to 0.1	47 to 3.9	65	1 to 2	3.28 to 6.56	50 to 75	165 to 250
Charlottenburg	1,000,000	250	55	300	67			1.2 to 0.1	47 to 3.9	340			100 to 150	330 to 490
Hamburg	1,100,000	150	33	221	49.5	170	38	1.2 to 0.5	47 to 2	246	1.5	5	100	328

*Presumably Imp. gal.; add 1/5 to convert into U. S. gal.
†Material at all three places is cast iron, but Hamburg is "going in for steel."
None of three works employs waste detection or has dual fire system. All three metered: Köln and Hamburg use inferential meters; Charlottenburg, inferential meters and "wet." Stand-by charge in Köln and Charlottenburg (latter based on size of pipe); none in Hamburg.

city. The previously mentioned Hof water-supply system is employed here, and in this case the horizontal collecting main, which is at a level of 13 m. (42⅔ ft.) below ground, is of a diameter of 1,100 mm. (43 in.), and is 2,000 m. (6,560 ft.) in length. Two hundred 150-mm. (5.9-in.) supply pipes are tapped into this, these small pipes running into a sand bed at a depth of 28 m. (92 ft.) below ground. The collecting main, which is housed in a tunnel, runs into two wells in which the water rises to the rest level of about 7 m. (23 ft.), whence the water is pumped by four vertical compound steam pumps to a reservoir distant 5 km. (3.2 miles) at the main pumping station.

These four pumps are of varying ages, but similar in type, the oldest having been installed 23 years ago. They are of 140 hp., running at an average speed of 45 revolutions per minute (60 to 40), and pump against a total head of 2.7 m. (8.8 ft.), 0.4 m. (1.31 ft.) being suction head. The steam consumption was given me as 22 lb. per indicated horsepower. Each pump has a capacity of 1,550 cu.m. (346,000 gal.) per hour. Generally two pumps were in work.

Four Lancashire-type boilers working at a pressure of 10 kg. per sq.cm. (142 lb. per sq.in.) and with a superheat of 100 deg. C. are the boiler house equipment at this station, the evaporative power per boiler being 2 cu.m. (say 4,500 lb.). Two boilers were in steam, and this is usual. Boilers were hand fired; baby car transport for coal; no economizer. Thirty men in all were employed at this station.

The Wallensee pumping station is the biggest of the

The maximum allowed filtration rates are 50 liters per square meter-hour (1 gal. per square foot-hour) for the lake water and 300 liters per square meter-hour (6 gal. per square foot-hour) for the subsurface water. All the filters were covered in and in semi-darkness. On an average, scraping took place every four months and relaying about every four years, so that modern methods of sandwashing and cleaning had received no study, the job being of such a stand-by nature.

The subsurface water is aerated before filtration by flowing from an overhead tank through a brick-filled chamber, about ½-cm. (¼-in.) joints being left between the bricks to admit the air to the thin streams of water obtained from the numerous feed pipes in the tank bottom. These feed pipes were about 6 in. in diameter and of two heights above tank bottom—say 18 and 30 in. —to admit of two ranges of flow, which was controlled by penstocks from a main channel.

Steam Entirely Eliminated

The main pumping station was particularly interesting. Here steam has been entirely eliminated, the sources of power being electricity and oil. The total pumping capacity of the station is 21,000 cu.m. (4,700,000 gal.) per hour, the present reserve being 30 per cent.

The pumps are all single-stage centrifugal, the motor-driven pumps being of the vertical axis type, two of them having a capacity of 1,500 cu.m. (335,000 gal.) per hour and two double this. The efficiency of these pumps was given as 80 per cent, and this is accounted for easily by the very sweet delivery to the pump main. Of the oil-

driven pumps two were of 1,500 cu.m. (335,000 gal.) and two of 3,000 cu.m. (670,000 gal.) per hour, the pumps being horizontal axis with split casings and an efficiency of 76 to 78 per cent. Venturi meters were fixed on all delivery mains with what appeared to me extraordinarily small contraction distances. There were two common delivery mains on each side of the building, four pumps delivering into each main, the size of the main being 1,200 mm. (47 in.), but it was possible for either set of pumps to pump into either main. All the pump foundations were column-supported and all the delivery and common mains easily accessible. The remainder of the station capacity was obtained from three 1,000-cu.m. (224,000 gal.) per hour motor-driven pumps of the usual type.

Of the four diesel engines, two were of six cylinders and 620 hp., working at 240 revolutions per minute, and two of the same number of cylinders, 340 hp. and 320 revolutions per minute. They were built by the premier diesel firm of Deutz, and have the extraordinarily low oil consumption of 175 grams (0.385 lb.) per horsepower-hour. The oil was American in origin.

A stock of 200 cu.m. (45,000 gal.) was kept in steel tanks housed in what had been the old boiler house when steam drive was used. All oil was metered to the engines. The total engine room staff consisted of ten men—five fitters and five drivers—working an eight-hour shift. The engine room was beautifully kept.

Pumping station pressures were 38 to 40 m. (115 to 131 ft.) delivery, 4-m. suction. I gathered that boosting was used for some portions of the city.

It is interesting to note that this, the first Berlin waterworks, dating from about 1875, was due to the enterprise of an English company. The memory of the first chief engineer, Henry Gill, is perpetuated by a bronze bust.

Charlottenburg, a Part of Greater Berlin

A private company supplies water to Charlottenburg, the best residential area in Berlin, with an estimated population of about 1,000,000. The source of supply is subsurface, the works being in woodland country about 15 km. out of Berlin. In general this plant is similar to that at Köln.

The maximum daily output of the works is about 100,000 cu.m. (23,000,000 gal.). The small pipes supplying this amount of water to the horizontal collecting mains were of 170-mm. ($6\frac{3}{4}$-in.) diameter, 100 in number, and fixed at 25-m. (82-ft.) centers. The rest level of the subsurface water is from 7 to 8 m. (23 to 26 ft.) and the depth from which water is drawn is 20 to 40 m. (66 to 132 ft.) below ground. The water is heavily charged with iron in addition to manganese, the iron being eliminated by aeration and filtration in the usual way.

The raw groundwater is pumped to the filters by two vertical compound pumps, similar to those in Köln, but rather smaller.

There are eight circular steel filters provided with belt-driven agitators for aeration of the water about the sand surface. Of these I obtained no details, but washing was done by reversed flow. From the filters the water flows to a 10,000-cu.m. (2,240,000-gal.) reservoir, whence it is pumped into the mains.

The main pumping house equipment consisted of two horizontal compound pumps of a capacity of 1,500 cu.m. (335,000 gal.) per hour each and one turbine centrifugal set with a capacity of 3,000 cu.m. (670,000 gal.) per hour.

The boiler house equipment consisted of three Babcock-type boilers working at a pressure of 367 lb. per sq.in. and employing a superheat of 180 deg. C.

The Water-Works of Hamburg

Hamburg takes four-fifths of its water from the River Elbe. The intake is 15 km. (9.4 miles) out of Hamburg in open country, the river having a tidal range at this point of 2.5 m. ($8\frac{1}{4}$ ft.). The water is brownish in color and is highly polluted but not very turbid.

The pumping plant for the raw water consisted of seven horizontal compound steam pumps, each of a maximum capacity of 2,000 cu.m. (448,000 gal.) per hour. These pumps were remarkable only for the eccentric-driven wrist plate which actuated the valves on the pump chambers. Six pumps were so fitted, one having the ordinary spring-actuated valves. The plate type of valve had given no trouble. These pumps work against a head of 5 to 6 m. (16 ft. 5 in. to 19 ft. 8 in.), were fitted with jet condensation and ran on a vacuum of 96 per cent. Four Lancashire boilers working at 103 lb. per sq.in., without superheat, supplied the steam for these engines, which dated from 1892.

The raw-water effluent passed from these pumps to a large open channel about 30 ft. in width, which is spanned by a perforated wooden trough which receives the required dose of alum solution. The strength of solution is regulated by hydrometer and the amount admitted to the trough by a ball valve and slotted gate. The alum liquor, containing 18 per cent Al_2O_3, is prepared from crystalline alum of about nut size. The usual alum dose is 40 grams per cu.m. (2.8 grains per gal.). The alum-treated water passes by way of a channel at least half a mile long to four settling tanks of a total capacity of 450,000 cu.m. (100,000,000 gal.) and a depth of 3 m. (10 ft.). There appears to be a shortage of settlement for the period of sedimentation given, but this is presumably made up from subsurface water. By the time the water reaches the farthest tank it has lost most of its mud. The water remains in the tank for two to three days and is then chlorinated before admission to the filters, the dose being 0.6 mg. per liter. No taste troubles were observed. The settling tanks, brick-lined basins conforming to the natural slope of the local mud, are cleaned by gravitation to the Elbe. Cleaning takes place every three to four months. The long channel is cleaned by dredging. The filters are all slow sand.

The absence of open-jointed pipes to the central culverts is to be noted. The maximum velocity of filtration is 113 mm. per hour (say 2.34 gal. per square foot-hour). Before the war filters were operated at a maximum velocity of 65 mm. per hour, or 1.35 gal. per square foot-hour.

The total depth of filter was 3.4 m. (11 ft.) and it was customary to run the bed down to 70 cm. (20 in.) of fine sand before relaying. Beds were cleaned every four months and relaying thus took place at five-year intervals. The average daily filtration capacity of the plant is 190,000 cu.m. (42,500,000 gal.) in 22 filters, each of 7,650 sq.m. (82,000 sq.ft.) giving a total area of 1,800,000 sq.ft. There is an enormous reserve of land for filter extension between the settling tanks and the existing filters. Sand washing is on a home-made hopper system, the washer consisting of six hoppers in series, the feed pipe to the hoppers being about $2\frac{1}{2}$ in. in diameter and the injector water at a pressure of about 10 ft. for an approximate lift of 6 ft. There were four such washers, the whole being capable of cleaning the sand from one filter (7,000 cu.ft.) in eight hours. After

filtration the water is again chlorinated with a dose of 0.15 to 0.4 part per million gallons before passing to the two reservoirs which feed the main pumps.

The main pumping plant is in three houses, the total capacity being 23,000 cu.m. per hour (5,100,000 gal.), the reserve being estimated at 25 per cent. The pumping head is 56 m. (184 ft.) average.

No. 1 pump house contains three vertical pumps of 500 hp. and an hourly capacity of 1,800 cu.m. (400,000 gal.) each, and five of 1,200 cu.m. (270,000 gal.); the larger sets running at 60 revolutions per minute and the smaller at 42 revolutions per minute, the pressures in the two cases being 12½ and 10 kg. per square centimeter (175 and 142 lb. per square inch). These engines are triple expansion, with injection condensation, the smaller sets being twenty years old. Six Lancashire boilers provide steam for the larger sets and nine for the smaller, the pressures being as has been previously stated. The superheated steam temperature is 100 deg. C. The second pump house contains two turbine sets, running at 5,400 revolutions per minute, with an hourly capacity of 4,000 cu.m. (900,000 gal.) each. There are two Babcock boilers, each with a steaming capacity of 5,500 kg. (12,000 lb.) per hour, at a pressure of 230 lb. per square inch. Percentage of CO_2 was 10 and the evaporation ratio 8.2 steam to coal. Superheat 200 deg. C.

No. 3 pump house contains two compound vertical sets, each with a capacity of 1,800 cu.m. (400,000 gal.) per hour, for which four Lancashire boilers are provided. This plant is generally similar to that in the first pump house.

I am indebted to C. D. Pearson, engineer-in-chief and manager of the Shanghai Waterworks Company, Ltd., for permission to make use of the information given in this article.

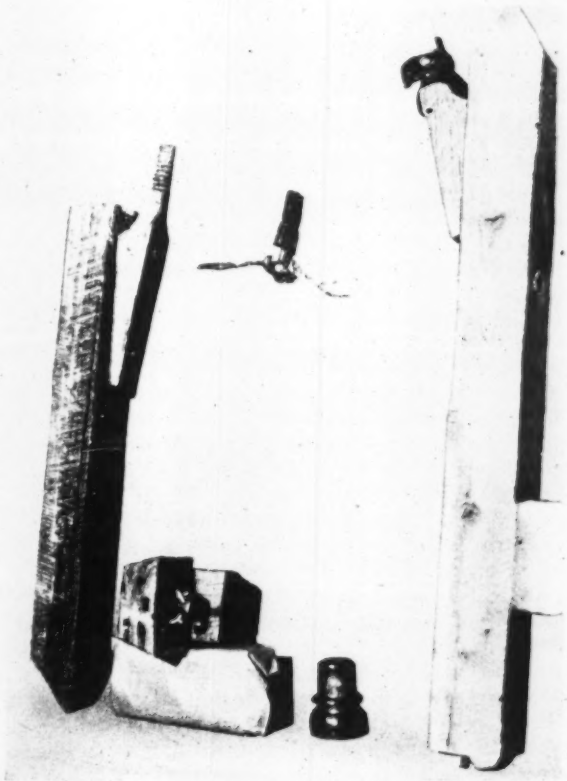
Relic of First Overland Telegraph Sound After 70 Years

By William M. Maule
Forest Supervisor, Mono National Forest, Minden, Nev.

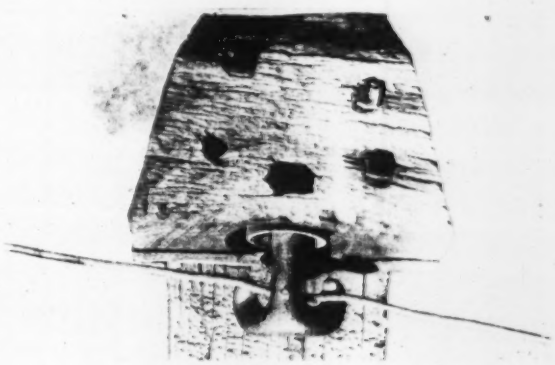
TELEGRAPH line construction of 70 years ago, when the Virginia City, Nev., to Salt Lake City, Utah, link completed the first overland telegraph line, is vividly disclosed by some relics recently discovered. This 700-mile connection across stretches of arid waste lands was completed between May 27 and Oct. 22, 1861, and was used on the day after its completion to transmit from the Atlantic to the Pacific news of the defeat of the Union army at Balls Bluff.

The original poles of the line were of heartwood incense cedar, and because of the dry climate the few which are still standing, although badly weathered, seem to indicate that they will wear away rather than decay. On one of these poles one of the original insulators was found still in position and intact. The construction consists of a block of California live oak fastened to the pole by four cut nails, the under surface of the block still bearing traces of a preservative tar treatment. The insulator proper was screwed into this block and consisted of an iron hook in a socket of gutta percha. Features of this 70-year-old relic may be seen in the accompanying illustration. When removed from the socket the hook was found to bear the following: "Goodyear Patent, May 5, 1851."

Search in the brush around the pole resulted in the finding of about 25 ft. of the original heavy black iron wire that was only slightly corroded. The locating of these relics was the result of successful explorations by the writer to find evidences of the original overland telegraph line.



70-YEAR-OLD TELEGRAPH RELIC
In the center is shown the core of the insulator. The section of pole at the right shows the old block-type insulator and smooth peg of the Aurora line; both as originally used.



ORIGINAL BLOCK-TYPE INSULATOR FROM THE GRAPEVINE LINE, CARRYING PORTION OF THE ORIGINAL WIRE
Note head of old "square" nails.

From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

A Sensitive Electrical Device for Determining Surface Elevations

By H. A. Dibbell
Assistant Engineer, Board of Water Supply, New York City

IN CONNECTION with hydraulic studies the engineers of the Board of Water Supply of the city of New York have developed an electrical device for determining the elevation of water surfaces which is a decided improvement over any apparatus previously employed.

The instrument consists of a primary and a secondary electrical circuit housed in a suitable carrying case. In the circuit diagram shown in Fig. 1, the principal items are:

H, an ordinary dry cell such as is used for ringing doorbells.

G, battery switch.

I, high-frequency buzzer (an ordinary buzzer, or even a doorbell with the tapper removed, would answer, but the note in the phones would not be as distinct).

F, a step-up, iron core transformer, the ratio between the number of turns on primary and secondary being 1 to 10. This transformer was constructed from the primary of a discarded Ford coil. The secondary of the Ford coil was carefully removed, as was one-half of the primary winding. Enough turns of No. 22 double cotton-covered wire were wound on over the remaining primary winding so that the secondary contained approximately ten times as many turns as the primary.

E, a single circuit jack such as is used in radio circuits. Instead of jack, binding posts could be used at *X* and *Y*.

D-D, binding posts for flexible lead *C*, connecting steel tape *A* and ground lead *J* to circuit.

B, small spring clip to attach flexible lead *C* to steel tape.

K, large spring clip to attach *J* to ground.

M, plumb bob with adjustable needle point.

L, metal pin thrust in ground. *K* may be directly clipped to any metal object which is grounded. A good pair of earphones such as are used in radio should be used in connection with the instrument. If jack *E* is used instead of binding posts *X* and *Y*, a plug will also be necessary.

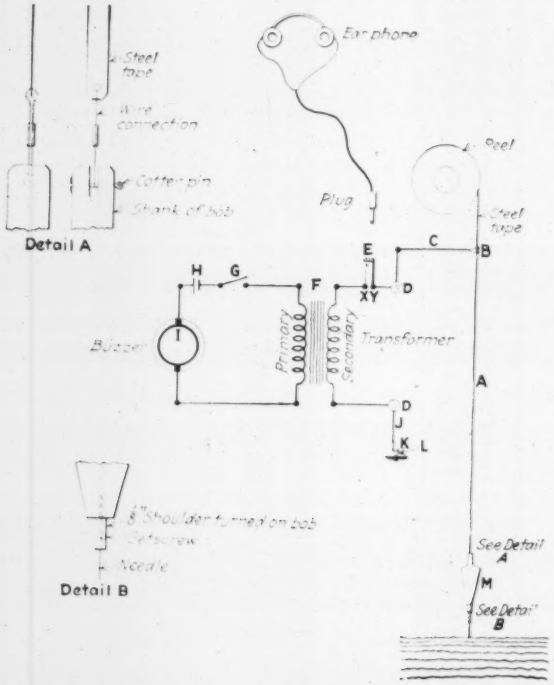


FIG. 1—DETAILS OF THE ELECTRICAL CONNECTIONS

The special bob *M* was made from an 18-oz. standard bob. The cap was removed and a hacksaw cut made in the shank of the bob. A hole large enough to accommodate a small cotterpin was drilled through the shank at right angles to and at the mid-depth of the slot. The steel point was placed in a lathe and a shoulder about $\frac{1}{8}$ in. in diameter and $\frac{3}{8}$ in. long was turned. This is used to slip a short piece of $\frac{1}{8}$-in. brass tubing over to protect the needle point when not in use.

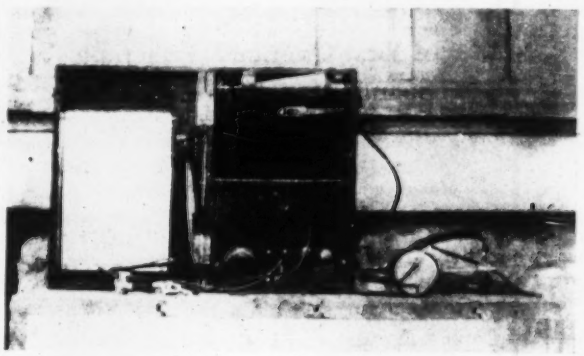


FIG. 2—CARRYING CASE FOR THE APPARATUS

A hole of sufficient size to accommodate a large sewing needle was then drilled in the end of the shoulder to a depth of about 1 in. A setscrew clamps the needle firmly in place.

The bob is secured to the steel tape by means of a wire connection (such as is used by fishermen to secure spinners, etc., to the leader) and the small cotterpin mentioned above. The hole in the steel tape was located so that the needle point would correspond to the zero of the tape. The distance from the needle point to end of shoulder was recorded on a tabulation which was tacked in the lid of the carrying case, and this distance was checked from time to time as the observations were made.

It is not necessary to use this special bob to secure accuracy. A standard 14-oz. bob was used with excellent results. The standard bob, however, is not so well adapted to measurements where a swift current is flowing, as the comparatively large surface exposed to the flow tends to create an appreciable swing.

Another type of bob was developed for use in restricted areas. This bob consisted of a piece of $\frac{7}{16}$-in. round steel about 8 in. long, slotted and drilled at one end, as was the special bob first described. The other end was ground to an easy tapering point. This type of bob gave excellent results in a $\frac{3}{4}$-in. iron pipe used as a temporary still-well. Under such conditions it is essential that the bob and tape be thoroughly insulated. This was accomplished by winding insulating tape spirally around the bob and tape. It was found necessary frequently to renew the insulation at the lower end of the bob to prevent the wet insulation from forming a short circuit.

For swift currents in unusually deep shafts (600 ft. was the maximum), a heavy bob was constructed from a sash weight and a thin iron rod, about ¼ in. A hole was drilled in the end of the sash weight, and the ¼-in. rod, ground to a point on one end, was driven in this hole. This construction presents a very small area to the action of the current, and the added weight tends to stabilize the swinging action. No weights or dimensions are given, as experiments for individual cases will best determine the requirements.

The carrying case was constructed of ⅜-in. pine. The inside dimensions are 11½x7½x4 in. deep. The lid is 1½ in. deep. The case may be made much smaller if no room for equipment is desired. The above dimensions allow ample space for phones, bobs, tape, etc. (see Fig. 2).

Methods of Using Instrument—A wooden straight-edge is used as a base for obtaining measurements. This straight-edge is placed across the top of manhole or other structure and leveled with the aid of a carpenter's level. Two small wedges are placed under the low end to maintain the level position of the straight-edge. The elevation of the top of the straight-edge is determined by direct vertical measurement to a benchmark in the structure or with an engineer's level and rod. A robe, coat or other insulating medium is placed on the ground or floor to insulate the observer, as the instrument is sensitive to grounds. (A distinct note will be heard in the phones through 10 megohms resistance.) In very damp locations it is advisable for the observer to wear light gloves.

In preparation for the operation the phone plug is placed in jack *E*, head phones adjusted and leads *C* and *J* connected to binding posts *D*. The clip *K* is clipped on ground and the plum bob lowered to the water surface. The lead *C* is then clipped to the tape at *B* and switch *G* closed. As the needle point of the bob is lowered to the water surface, a distinct high-pitched note will be audible in the phones.

Two methods of making the observations are used. Numerous comparisons tend to indicate that either method is equally accurate. Method 1 was used when a knowledge of the range of surge as well as the average elevation of the water surface was desired. Method 2 was used when the average elevation of the water surface was the only requisite.

Method 1—The tape was lowered until the note in the phones indicated contact with the water. The tape was then gradually raised until only an instantaneous contact was made at the extreme high range, and the tape was read. This operation was repeated five times (ten in case of violent and non-periodic surge). The tape was then lowered until contact was continuous and gradually raised until an instantaneous break indicated the extreme low range and the tape read. As before, this operation was repeated either five or ten times. In still water readings seldom varied more than 0.001 ft.; in water flowing at rate of 4.5 ft. per second the averages of different sets of ten readings should not differ by more than 0.03 ft.

In a comparison of 60 sets of observations taken at the downtake and uptake shafts of the Rondout, Wallkill, Hudson River and Croton pressure tunnels of the Catskill aqueduct, the maximum surge was 2 ft. and the greatest difference between the averages of different sets of twenty readings each was 0.07 ft.

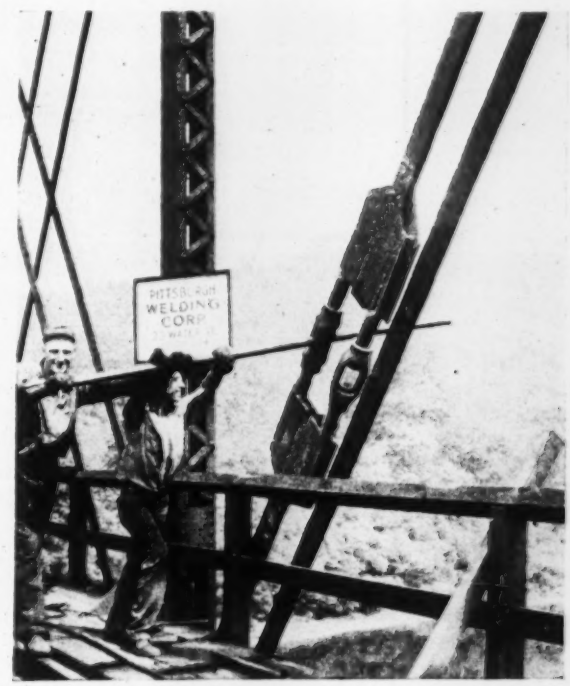
The conditions at these shafts are probably as severe as will ever be encountered in making measurements of this kind. The results obtained tend to show the accuracy which may be expected under abnormal conditions.

Method 2—This method of taking observations is similar to the first, with the exception that no effort is made to measure the crest and trough of the surge. Two sets of five or ten readings (depending on the tranquillity of the water surface) are taken at any convenient intervals and the averages are compared and averaged as stated before.

Turnbuckles Welded Into Bridge Eyebar Diagonals

By H. F. Cole
General Electric Company, Pittsburgh, Pa.

IT WAS recently necessary to provide some means of adjustment in the eyebar tension members of a three-span railroad bridge over the Kiskiminetas River near Pittsburgh, Pa. Particularly in two of the spans, these eyebar diagonals, which were used in pairs, had become



RESTRESSING BRIDGE DIAGONAL WITH SPECIAL TURNBUCKLE DEVICE

so elongated through wear and vibration that one member of the pair was considerably understressed. The repair work consisted in inserting a special turnbuckle detail into one of the diagonals with the use of arc welding and then drawing up the turnbuckles until the diagonal carried approximately the same load as the other eyebar in the pair.

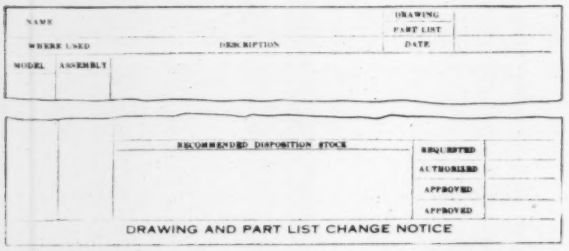
As shown in the accompanying illustration, the repair device consisted of two turnbuckles welded between a pair of wing plates at either end. These wing plates were then welded to the eyebar and the workmanship of the weld was tested by drawing up each turnbuckle while the weld was subjected to blows struck on the corner and ends of the plates with a 10-lb. sledge. Small cover plates were finally welded to the wing plates as an additional factor of safety, after which the section of diagonal, about 18 in. long, between the wing plates was

cut out. By vibrating both bars and counting the number of vibrations per minute, it was found quite feasible to adjust the turnbuckles until an equality of loading between the two eyebars was obtained. The device was designed so that the two turnbuckles would develop about 25 per cent more strength than the original bar, and a sufficient number of linear inches of weld was deposited to develop more than the strength of either the turnbuckles or the plates. The turnbuckle arrangement was developed by the Pittsburgh Welding Corporation, which company also did the repair work.

Record of Drawing Changes

By Morton Schwam
Philadelphia, Pa.

WHEN making changes on drawings a record of the changes should be kept in the files for future reference. Such record may be made on a convenient form of change slip as shown herewith. At the time of making a change, the change should be accompanied on the original tracing by a letter of the alphabet or a change



CONVENIENT FORM FOR RECORDING CHANGES ON DRAWINGS

number inclosed in a circle. The change slip is made out by the draftsman making the change noting in detail the nature of the change, what the particular dimensions or notes were on the tracing before the change and what they were changed to. The change slip is then issued when the drawing is released for reissue as detail information and calling attention to all interested parties of the changes made. The change slip is laid alongside of the tracing when being blueprinted and thus will be part of the one blueprint. Such record of changes will prove invaluable when at some later date someone desires to know what and why a particular change was made.

Chart for Beam Design Gives Equivalent Distributed Loads

By Ernest McCullough
Consulting Engineer, Long Island City, N. Y.

IN DESIGNING beams and girders the old method of reducing concentrated loads to an equivalent distributed load is still in common practice, but most designers use tables to obtain the proper conversion factor. The diagram given here makes the use of tables unnecessary, resulting in a considerable saving in time. The diagram should be reproduced on tracing cloth or paper, or, preferably, on transparent celluloid. The horizontal lines may be either $\frac{1}{8}$ or $\frac{1}{4}$ in. apart, according to the preference of the designer, while the width may be varied to suit working conditions. For most cases an upper width of $6\frac{1}{2}$ in. and a lower width of 3 in. will prove convenient, each divided into sixteen uniform parts. Connecting lines are drawn and labeled as shown.

To use the chart, place it on the drawing horizontally with the outer line at the supports of the beam or girder. The factor for converting concentrated to uniform load will be found on the sloping line which intersects the loaded point of the beam. The sum of the equivalent distributed loads, added to the weight of the beam or girder and of the fireproofing on the haunches, gives the

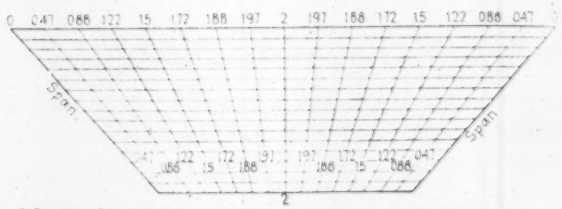


DIAGRAM GIVING FACTORS FOR CONVERTING UNIFORM TO EQUIVALENT DISTRIBUTED LOADS

total uniformly distributed load to be used in obtaining the size of the member. If the concentrated loads are distributed fairly uniformly, one-half the total load may be used as a reaction at either end, but with unequally distributed loads, the true reaction should be obtained by the usual method.

The diagram is based upon the equation

$$M = \frac{Pa(L - a)}{L} = \frac{WL}{8}$$

in which M = moment; P = concentrated load; W = uniform load; L = span; and a = distance to the uniform load from the nearest support.

Test Model Used in Design of Kill van Kull Arch Bridge

IN ORDER to check the design calculations of the 1,675-ft. Kill van Kull arch bridge in New York City, the model shown in the accompanying illustration was constructed by the bridge engineers of the Port of New York Authority. Particular use was made of it in checking lateral distortions of the structure and the effect of sway bracing on vertical deflections. It is now on exhibition at the Museums of the Peaceful Arts, 24 West

FIG. 1—KILL VAN KULL ARCH BRIDGE MODEL
Showing weights (containers filled with shot) which produce lateral deflections. Note dials on top chords for indicating vertical deflection.

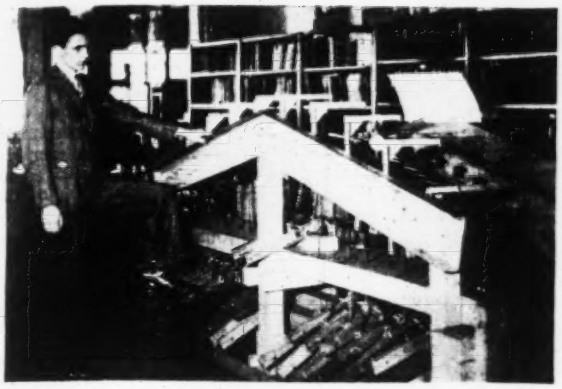


FIG. 2—LEVER SYSTEM FOR APPLYING VERTICAL LOADS TO ARCH MODEL

40th St., New York City. It is about 9 ft. long, 1 in. of length on the model representing 16 ft. of the actual arch. The model is made of brass. Each of the two principal trusses was cut out of two brass plates which were then brazed together at the center. The laterals and portal members are attached by solder. As one result of the use of the model the amount of silicon steel to be used in the structure will be materially increased over the original plans.

Concrete Tower 220 Ft. Tall Result of an Englishman's Hobby

By Wyatt Brummitt
Portland Cement Association, Chicago, Ill.

IN HAMPSHIRE, England, stands a strange tower of monolithic concrete. Its purpose, if it had any, is unknown, but it has been called Peterson's Folly, inasmuch as it was built about 1880 by A. T. Peterson, a judge who had retired from the bench in India and taken up concrete construction somewhat as a hobby in order to provide work for laborers and artisans in his district. At first, his efforts were expended on bettering the housing conditions of his neighbors and tenants, and as a result many farmhouses are still in use which were built more than 50 years ago by this concrete enthusiast. The nearest source of cement was on the Isle of Wight, where there were the beginnings of what is now the Vectis works, supplying a fair grade of portland cement. At first the farmers hauled the cement from the port of Southampton, but later sailing barges brought it directly to Lymington, a harbor not far away.

After building a water tower of little more than conventional height, Judge Peterson began in 1879 the tower which ultimately reached a height of 220 ft. Using one set of forms, he completed the job in six years, working only in spring and summer. It stands today on its 22-ft. square base, in perfect condition. Although it is slightly out of perpendicular, that is the way it was built. An open stairway circles upward inside the tower, and a landing is provided every 10 ft., where a room has been built.

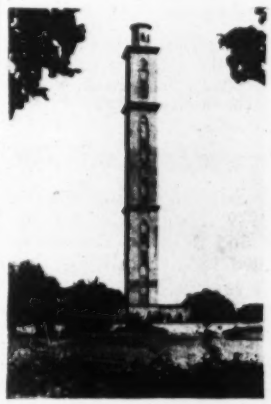


FIG. 1—220-FT. CONCRETE TOWER

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Refuse Incinerator Specifications

Sir—In your issue of Sept. 5, p. 383, there appeared a transcript of "Tentative Incinerator Requirements for San Francisco," contained in a report made to Mayor Rolph by M. M. O'Shaughnessy, city engineer. Elsewhere in the same issue there is an editorial entitled "Refuse-Disposal Pitfalls." Both of these articles are in the line of advocation of requirements to be included in engineers' specifications covering the furnishing and erecting of incinerators.

The suggestions contained in Mr. O'Shaughnessy's report and the editorial are excellent, and if carried out cannot fail to be an improvement on the present loose methods of drawing up incinerator specifications; but these suggestions, while pointing the way, do not go far enough.

A city contemplating the construction of an incinerator plant and desirous of obtaining bids thereon should most assuredly furnish definite information respecting the composition of the material to be burned. The data in this line ordinarily furnished the contractors by the average American city engineer are very general and indefinite, and when an attempt is made to specify certain tests to determine the composition of the refuse, usually such specifications are impractical, indefinite and sometimes actually misleading.

The common run of specifications covering refuse incinerators, as prepared by engineers in this country, leaves much to be desired. No engineer in purchasing pumping equipment, for example, would neglect to specify the conditions under which the pump shall operate, nor would he fail to a larger extent to base his selection from the various types of pumps submitted on the guaranteed efficiencies of the pumps. Nor would an engineer, contemplating the purchase of a steam engine, neglect to take into vital consideration the guaranteed steam consumption per indicated horsepower-hour. An engineer in purchasing most types of equipment does not simply decide as a matter of opinion whether or not that particular machine will make a good appearance and *probably* do the work required of it, but he definitely requires a rigid guarantee that it shall do the work specified, and do it at not less than a minimum efficiency. There is no need of purchasing an incinerator on any basis less definite than that on which other equipment is purchased, nor is it any more difficult to determine whether or not the guaranteed requirements have been met.

It would not seem to be an extravagant statement to assert that practically all of the better types of incinerators, if provided with proper storage space, can be operated so that the plant itself, as distinguished from the process, need not be a nuisance. During the process gases are continually being given off from the burning refuse. If these gases contain not more than a minimum amount of dust and certain objectionable gases and if the resulting ash and clinker contain not more than a minimum quantity of organic matter, then the incinerator is functioning properly and not as a nuisance. These results need not be left to the mere opinion of the operator. They are subject to definite, scientific proof through the analysis of flue gas, clinker and ash.

Beyond reasonable doubt a certain standard minimum requirement as to flue-gas analysis and clinker and ash analysis should be inserted in every incinerator specification. Foreign countries, with their longer and more specialized experience in the incinerator field, have set up certain legal standard requirements which must be met by every incinerator builder. Knowledge of these standard requirements is available to all engineers interested in this important phase of municipal sanitation and until an American

standard is determined might well be used by engineers in this country.

It seems to me that some very important clauses might well be added to the recommendations of Mr. O'Shaughnessy, and noteworthy among these are guarantees that the flue gases shall meet a certain specified minimum requirement, and also the guarantee that the clinker and ash shall contain not more than a certain minimum percentage of organic matter.

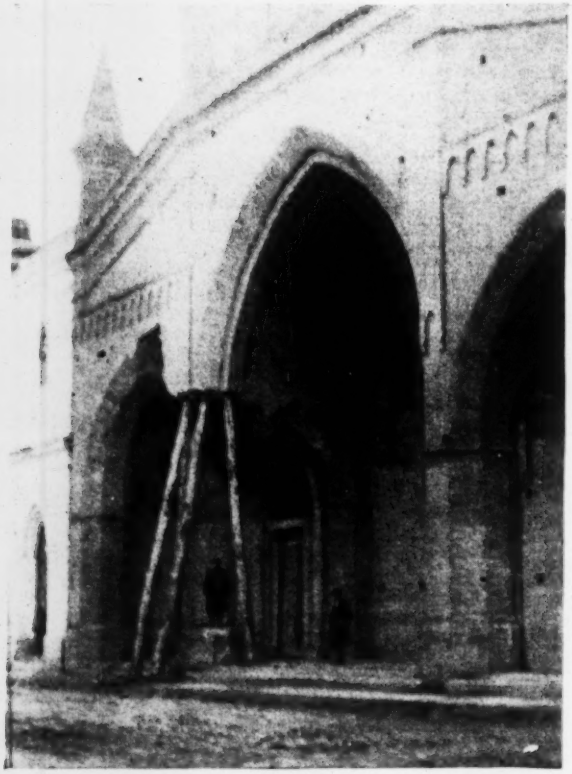
Your editorial, already referred to, is a splendid commentary on the existing unsatisfactory state of the art of incinerator specification. It is urgently necessary that continued publicity of this sort be given to this very important question, because the absence of knowledge and the application of specialized knowledge to the incinerator problem of America are permitting the widespread installation of unsuited and nuisance-creating incinerators, the majority of which do little more than gesture at the problem before them at the expense of the pocketbook of the taxpayer. If incinerator specifications were properly drawn and suitable guarantees insisted upon, the art of refuse disposal would soon take its place among other far better regulated branches of municipal sanitation.

New York City, Sept. 23, 1929. GEORGE A. JOHNSON, Consulting Civil Engineer.

Earthquake Leaves Arch Unsupported

Sir—In connection with the work of the Chilean government in its dam-building program, the relation of earthquakes to stability is one which gives me much concern. Dam failures are too frequent without this added menace, so I have devoted much of my time to this important question and have been diligent in my investigations of the damage to structures in the last two serious shocks: Talca, 1928, and Atacama, 1922.

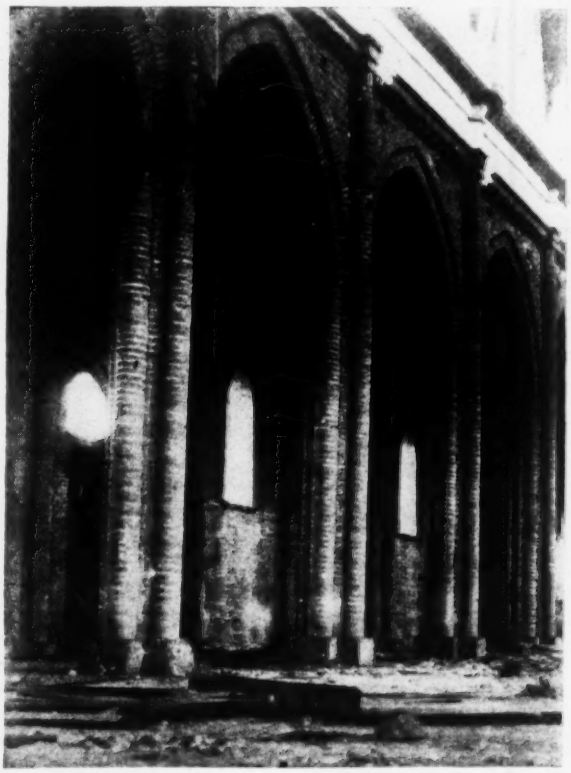
During a recent visit to Parral, some 50 km. south of Talca, which suffered much damage in this shock, I was directed to the Cathedral of the Order of Franciscans to inspect the damage done to this edifice.



EXTERIOR OF CATHEDRAL AT PARRAL, CHILE

On nearing this structure, a building of brick 30x90 m., my attention was drawn to the central Gothic arch, one column of which was missing, the arch at this point being supported by four slender poles. My first thought was that the shoring was inadequate to carry the superimposed load and I wondered why steps had not been taken to make this safe. Imagine my surprise when I was told that the arch had stood for ten days after the earthquake without support of any kind. This seemed impossible. It then occurred to me that secondary arch action had been responsible for its remaining.

On making an investigation I found that this was not possible, as a large, open crack extended up through the



INTERIOR OF PARRAL CATHEDRAL
The columns contain one steel rail. Some were slightly deformed.

crown of the arch. I was assured that no reinforcement of any kind was used.

The accompanying exterior view, taken at the time of my visit, gives some idea of the situation. Perhaps some of the fellowcraft can suggest an explanation.

Santiago, Chile, July 30, 1929. JAMES B. GIRAND.

Support against overturning given to the corner column by the adjoining building, together with the cantilever action of the interior wall, would appear to account for the unusual condition.—EDITOR.

Progress in Car-Ferry Railway Links

Sir—In reading *Engineering News-Record* for Aug. 22, 1929, in your article "Progress in Car-Ferry Railway Links" I find an error. Instead of nine across-the-lake ferries operated by five railways among fourteen ports the following is correct:

Pere Marquette operates on Lake Michigan seven boats, with two new ones building; Grand Trunk Railway operates four and Ann Arbor six. On the Detroit River there are twelve river car-ferries and on Lake Erie three, making a total of 34.

L. R. KENT,
Chief Engineer of Steamships,
Pere Marquette Railway Company.

Manitowoc, Wis., Aug. 27, 1929.

News of the Week

Plans Progressing for New East River Tunnel

As a result of conferences between Chief Engineer Ridgway of the New York Board of Transportation, the officers of the East River-38th Street Tunnel Committee and the Fifth Avenue Association, work has been begun on drafting plans for the tunnel. The Board of Estimate and Apportionment now has before it for approval the contract plans for boring under the East River. This tunnel, it is expected, will afford much needed traffic relief to Mid-Manhattan and the entire City of New York.

City Engineers at New York Sue for Reinstatement

A motion for a writ of mandamus to compel Commissioner John H. Delaney and the Board of Transportation of the city of New York to reinstate the engineers of the board who were laid off last June has been filed by counsel for the Union of Technical Men. The union contends that in dismissing the men the board violated the civil service laws. At the time the men were laid off the Board of Transportation stated that it was impelled to take that action because the quality of the work of a large number of the men had been impaired by their affiliation with an outside organization which had conducted a turbulent agitation among them. The disorganization which the board claimed resulted from this agitation precipitated a reorganization of the engineering department in which about 300 of the junior engineers were laid off and the handling of their work was distributed among the higher paid men.

Colonel Wooten to Retire on Feb. 1 Next

Col. William P. Wooten, Corps of Engineers, has applied for transfer to the retired list of the army Feb. 1 next, after more than 35 years' service and President Hoover has approved the application and has granted him leave of absence from Oct. 25 to the date of his retirement.

Besides having an enviable career in the Philippine insurrection and the World War, Colonel Wooten has to his credit many important engineering activities. In 1902-05 he was in charge of all the field work in the construction of the Washington city filtration plant near the Soldiers' Home; in 1905-08 he had charge of river and harbor improvements in Texas; in 1911-14 he was in charge of all harbor improvements and fortification work in the Hawaiian Islands; in 1919 he was in charge of the engineering district at Newport; in 1920-21 he was in charge of the lake survey at Detroit, and, in collaboration with Mr. Borden, Canadian engineer of railways and canals, made a report to the International Joint Commission on the practicability and cost of improving the St. Lawrence River from Lake Ontario to Montreal; in 1926-27 he was at New Orleans as division engineer of the Gulf Division, during which period he served as chairman of the Spillway Board, whose plan for the reduction of the flood stages on the lower Mississippi proposed the principal engineering features of the project now in course of execution.

Southeastern States Suffer From Heavy Rains

Aftermath of Tropical Storm Causes Minor Damage Over Wide Area—High Precipitation Recorded

Engineering News-Record Staff Report

SURPRISINGLY little major damage to engineering works resulted from the tropical storm which last week swept across the entire Southeast and up the Atlantic coast as far as New England. Several cases of accidental drowning were reported, and some damage occurred to roads, bridges and railroads but, on the whole, losses were comparatively unimportant as compared with that done by previous storms.

Exceptionally heavy rains occurred in North and South Carolina and in Georgia, with somewhat less precipitation north and south of these states. From early reports it is believed that all rainfall records for the states named were broken for a storm of such a large area. Beginning at the upper reaches of the system of rivers extending from the mountains to the sea, the storm traveled diagonally across the watersheds of these streams, with the result that flow from the headwaters reached the central portion of the Carolinas while the storm there was still in progress. Precipitation of from 7 to 11 in. occurred over an area of probably 100,000 square miles, with 12 in. reported in a portion of South Carolina and 15.2 in. in Glenville, Ga.

Railroads suffered relatively little physical damage. The Southern Railway lost a timber trestle approach to its bridge over the Savannah River at Augusta, Ga. Other minor bridge and trestle damage occurred, and in various places train service was annulled or rerouted, this being done usually on branch lines.

Highway damage was confined to shoulder washouts, some bridge losses and a few cases of pavement undermining. More detailed accounts of the effects of the storm in the various states is given in the series of reports which follow.

Control Works Minimize Damage in North Carolina

The outstanding engineering experience of the storm was the remarkable effect of the regulation works of the Duke Power Company on the Catawba River in North and South Carolina. This stream and its tributaries have caused much damage in the past, the

FLOODED ROAD NEAR SMITHFIELD, N. C.

worst flood occurring in July, 1916, when many millions of dollars damage resulted. Since that time, however, a system of twelve reservoirs has been placed in service by the Duke Power Company extending from Bridgewater, N. C., to Wateree, S. C. Water levels in the twelve reservoirs had been drawn down by operations prior to the flood from 3 to 7½ ft. below the dam crests. The storage space thus available permitted the checking of a very considerable part of the water from the headwaters of the stream, where the runoff is exceptionally fast. By skillful manipulation of outlet gates it was possible to flatten out the flood flow to a remarkable extent, so that, although the flow in some of the tributaries exceeded that of the 1916 flood, the damage in the entire watershed was confined almost entirely to overflowed farm lands. In a similar manner the reservoirs of the hydro-electric developments on the Yadkin River in North Carolina controlled the flood in that stream, which approached very close to the record.

County roads and bridges, especially in the central part of the state, were considerably damaged, but most of these were minor local structures of comparatively limited size and importance. State highways and bridges came through the storm with very little damage. John D. Waldrop, state highway engineer, sends the following information:

From 2 p.m. Sept. 30 to 2 p.m. Oct. 3 9.12 in. of rain fell in a portion of North Carolina. The maximum fall was in the vicinity of Moncure, in Chatham County, where there was a precipitation of 11.56 in. in 24 hours. This sudden rainfall caused high water on all of the streams in the eastern part of the state as the excessive amount of water worked its way toward the seacoast. The heavy precipitation put all streams out of their banks and the highways of the state were blocked in 29 different places due to the high water exceeding the bridge capacities, thus causing the roads to be inundated.

FLOODED TRACKS OF THE NORFOLK SOUTHERN RAILROAD

When the water receded it was noted that wherever grass shoulders were in place adjacent to each side of the pavement the damage done was negligible and where no grass had yet been obtained that there was a decided shoulder wash. It was also gratifying to learn that all of the bridges built by the State Highway Department remained intact and withstood the flood damage.

Flood Records Broken by Several Georgia Rivers

Damage in Georgia was confined chiefly to the vicinity of Augusta, although minor losses occurred in other sections, and agricultural damage was experienced throughout the state. Conditions at the time of going to press are summarized in the following communication from Searcy B. Slack, bridge engineer of the Georgia State Highway Board:

Heavy rainfall which occurred in the eastern half of Georgia during the latter part of September and early in October caused a large amount of damage to highways and crops. Water in the Savannah River equaled the highest known records. The Ogeechee, Satilla and a number of other smaller streams established new marks from 1 to 5 ft. higher than any previous records. The water is still so high in the larger streams that it is impossible to estimate amount of damage which has been done to the bridges and approach fills. At Glenville 15.2 in. of rainfall occurred in a period of 20 hours. At Augusta two extremely heavy rains occurred; the first one 6.6 in. of rainfall in a 24-hour period and the second 7.9 in. in a 12-hour period.

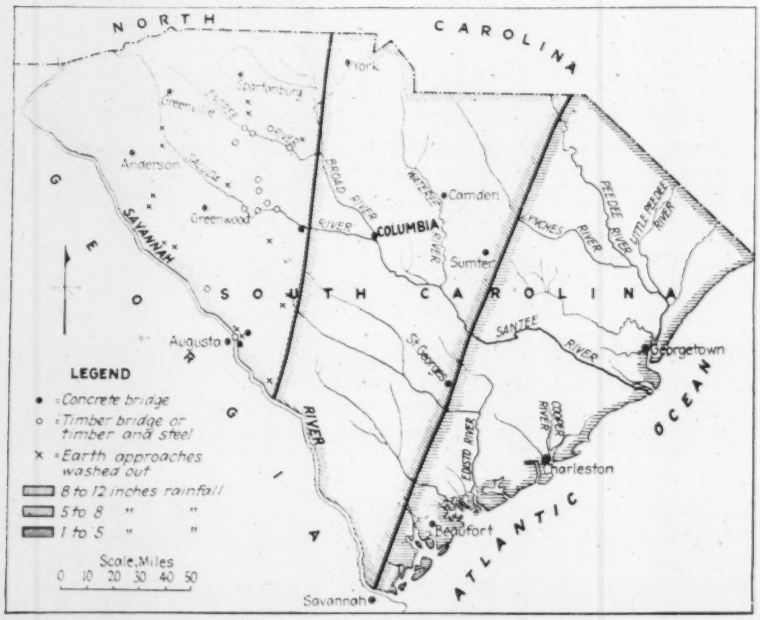
At the interstate bridge between Georgia and South Carolina three miles south of Augusta, known as the Sand Bar Ferry bridge, 440 ft. of the concrete approach trestle and 600 ft. of timber trestle were lost due to change in channel of the Savannah River. In the city of Augusta two river spans of the Center St. bridge were carried away, and also 100 ft. of the trestle approach to the Thirteenth St. bridge.

In other parts of the state a number of small bridges were damaged and approach fills washed out. About 2,500 ft. of concrete pavement was undermined by water from culverts which were stopped up. At Hurricane Creek crossing, U. S. Route No. 1, three miles north of Alma, Ga., about 1,000 ft. of pavement was lost and the earth embankment was cut.

South Carolina Bridges Suffer From Drift

Abundant rainfall was experienced over the entire State of South Carolina, as shown on the accompanying map supplied by Charles H. Moorefield, state highway engineer, who states that the excessive rains extended from Sept. 26 to Oct. 2, with a slight intermission from Sept. 28 to 30. The most serious damage was caused to agricultural interests, the long storm period having caused rotting and sprouting of the unharvested crops. Damage to cotton was particularly severe. Flood stages in several of the major streams were at record height, this applying particularly to the Savannah River, the Enoree River and the south branch of the Edisto River. Most of the damage to highways and railways was caused, in Mr. Moorefield's opinion, by clearing and lumbering operations in the valleys above bridges, which resulted in changes in the regimen of the streams which had not been calculated upon in their design. In addition to the bridge losses, embankment approaches were washed out in several instances. The more severe cases of road and bridge damage are shown on the accompanying map.

In the vicinity of Augusta, Ga., two spans of the steel bridge over the Savannah River on Highway No. 1 were lost, as well as the paved embankment approach on the South Carolina side. The trestle approach to the bridge at North Augusta on Highway No. 25 was also damaged. On Route 28 the bridge crossing the Savannah River was damaged because of a change in the river channel at this point. The structure consisted of five steel spans across the main channel with a concrete trestle



RAINFALL AND BRIDGE LOSSES IN SOUTH CAROLINA

approach 500 ft. long on the Georgia side. This concrete approach when constructed in 1922 was over relatively high land which, although subject to overflow, showed no signs of erosion. A change in the current direction, probably brought about by the Augusta levee, caused heavy erosion through the length of the concrete trestle, and a large part of this structure was lost. It is estimated that reconstruction will cost in the neighborhood of $70,000.

Near Langley, S. C., on Highway No. 1, a concrete bridge was lost, due to a drift jam caused by the washing out of a railroad trestle immediately above. On Route 391, between Batesburg and Prosperity, a concrete bridge was destroyed by a log jam brought down by clearing operations carried on immediately above. The loss in this case will amount to about $60,000. Other bridge damage throughout the state is estimated, roughly, at about $70,000, and embankment washouts will probably aggregate $50,000 more. Mr. Moorefield estimates that flood conditions will continue until about Oct. 15, but little further damage is expected.

CRABTREE CREEK OVERFLOWS STATE HIGHWAY 50 NEAR RALEIGH, N. C.

The Saluda River near Columbia, S. C., brought down a flow estimated at 300,000 sec.-ft. at its peak, filling the basin back of the partly completed Saluda earth dam, although the outlet conduits were opened and discharged more than 80,000 sec.-ft. No damage resulted here.

Coleman Nominated President of Am. Soc. C.E.

John F. Coleman, of New Orleans, was named as official nominee for president of the American Society of Civil Engineers by its nominating committee at Boston on Oct. 7. Mr. Coleman is one of the foremost engineers of the South. In his own city he has been active in political and civic work as well as in engineering. He has been active in the affairs of the American Society of Civil Engineers for many years, having served as a director from 1915 to 1917 and as a vice-president from 1918 to 1919.

The board of direction at its meeting held just prior to the fall meeting of the society acted upon 160 applications for membership and transfer and authorized the establishment of local sections in Porto Rico and New Mexico. It also approved the establishment of a student chapter at the University of New Mexico, the 95th to be established.

Announcement was made by the board of the following awards of medals and prizes to be made at the annual meeting in January: Norman medal to Commander G. T. Rude for his paper on Tides and Their Engineering Aspects; Thomas Fitch Rowland prize to D. B. Steinman and William G. Grove for their paper on the Eyebar Cable Suspension Bridge at Florianapolis, Brazil; James Laurie Prize to R. H. Keays for his paper on the Construction Methods on the Moffat Tunnel; Arthur M. Wellington prize to F. C. Carstarphen for his paper on Aerial Tramways; Collingwood prize for juniors to William J. Cox for his paper on Automobile Hazard in Cities and Its Reduction. No recommendation was made for the award of the Croes medal.

The board of direction instructed the representatives of the society on Engineering Council to oppose pending legislation in Congress looking toward the restriction of toll bridge development and construction. Honorary membership in the society was conferred upon George F. Swain, of Harvard University.

Safety Congress Stresses Proper Traffic Control

Five sessions of the Public Safety division of the congress of the National Safety Council at Chicago Sept. 30 to Oct. 4 were devoted to traffic control in municipalities. Especially of note for traffic engineers was a trip around Chicago and a subsequent discussion of traffic problems noted on the trip by Leslie J. Sorenson, Chicago traffic engineer; a thought-provoking paper by Hawley Simpson, traffic engineer, Essex County, N. J., in which a plea was made for an engineering analysis of the enormous amount of traffic data being collected, and a glimpse into the future highway development by Robert Kingery, secretary, Chicago Regional Planning Association.

Neglect of the engineering of traffic control is because it is not of a spectacular nature, said Mr. Simpson. A world of statistics has been collected as to accidents, but little analysis has been made and few remedies have been suggested. Little is known concerning the actual degree of safety afforded under various conditions by traffic signals, parking, large and small radius curbs, of the effect of street lighting, traffic circles, and protected safety zones. He suggested a "bureau of public accident prevention," whose main duty would be the analysis of reports, preparation of charts and diagrams showing existing conditions and suggestions for practical changes. A spot or pin map of accidents and an intensive study of the most dangerous intersections as they develop on the map was recommended.

Mr. Simpson came nearer proposing a rule for the installation of stop-and-go signals than has yet been put forward. An analysis of 32 signalized and twenty unsignalized intersections indicated that with more than 1,000 cars per hour accidents were reduced 35 per cent, with 800 to 1,000 cars there was a smaller decrease and with less than 800 no decrease and oftentimes an increase in accidents. A comparison of two six-month periods at the beginning of 1928 and 1929 indicates that the traffic-light intersections are 50 per cent more hazardous after signalization.

Separation of highway grades is the chief agency of effectiveness in aiding traffic movement, in the opinion of Mr. Kingery. This work of grade separation of highways is immediately before the country and should, he held, be well under way in the next ten years. Traffic circles are considered by Mr. Kingery not as a substitute but as a preliminary step for less congested intersections while waiting for separation of grades.

Dr. John Dill Robertson, president, West Chicago Parks Commission, presented an analysis of 12,110 accidents on the 42 miles of boulevards, from which the definite conclusion was drawn that the 428 unsignalized intersections were far less hazardous than the 106 crossings equipped with stop-and-go lights. At the latter points 4,066 accidents (33.9 per cent) occurred, whereas but 1,738 (14.3 per cent) took place without such lights, although at every intersection some kind of sign is placed.

As the work of the Public Safety divi-

tion has been largely devoted to street and highway traffic, such a section of the division with appropriate officers for more direct guidance and efficiency was petitioned for in a resolution sponsored by Burton Marsh, Pittsburgh.

Construction Section

The Construction section afforded an opportunity in two sessions for the presentation of ten papers. Robert Knight, deputy building commissioner, Chicago, and president, Building Officials Conference of America, outlined safety in construction from the latter position. Laws, he said, cannot make "foolproof" the work of construction or use of a building. Knowledge of the hazards of the builder's trade and of his limitation as to skill and other ability to cope with them is also essential.

In William G. Wheeler's paper, on "Results Through Voluntary Co-operation in Accident Prevention in Construction," he deprecated much of the loose talk of safety speakers in quoting statistics of the hazardous nature of construction. Mr. Wheeler admitted the contention, but claimed it was because of the lack of co-operative action on the part of all of the elements engaged in the industry. No well-directed and concerted group informational effort has been made to improve the condition. Better organization of the contractors for accident prevention was suggested. Along this same line was a talk by Willard Chevalier, publishing director, *Engineering News-Record*, on "A Voluntary Critic's Conclusions Concerning the Construction Safety Program."

Port Authorities Decide to Incorporate Association

Formal incorporation of the American Association of Port Authorities was decided upon unanimously at the eighteenth annual convention held Sept. 23-26 at Quebec, Canada. At the same time changes were made in the method of publishing *World Ports*, the official organ of the association. The administration of the publication will in future be entirely dissociated from the duties of the secretary, and the magazine is to be placed in the hands of Perry Young, managing editor. A suggestion that the name of the association should be changed, the word "International" being substituted for "American," was referred to the incoming directors for action, and was also placed on the agenda for next year's meeting. It is felt that the new title would be more appropriate, as the field covered by the association includes ports in Canada and in South America, as well as ports in the United States.

Major-Gen. W. L. Sibert, of the State Docks Commission, Mobile, Ala., was elected president. Vice-presidents chosen were: M. W. Oettershagen, harbor engineer of the Bureau of Rivers and Harbors, Chicago; Walter B. Allen, Seattle; J. Gordon Bohannan, chairman of the State Port Authority of Virginia. The next annual convention will be held at Milwaukee, Wis.

American Public Health Assn. Meets in Minneapolis

With ten sections and nearly 200 papers and reports to be presented, as well as a large exhibit to see, the engineering delegates to the American Public Health Association at Minneapolis, Sept. 30 to Oct. 4, were all but lost in the program, but not in effectiveness, since one of their number, George W. Fuller, president of the organization, gave a masterful diagnosis of the whole public health problem, the relation of the association to the questions of the day and an engineering type of procedure in revamping the work of the association more fully to fulfill its mission. Mr. Fuller is the third engineer to head this association since its formation 58 years ago, Rudolph Hering and Henry F. Vaughan preceding him.

Of special interest to the sanitary engineer were four sessions of the Public Health Engineering Section in which were reports on current practices of garbage and sewage disposal and water-supply control. J. A. Childs, chief engineer, Metropolitan Drainage Commission of St. Paul and Minneapolis, outlined the sewage and drainage problem of the region, which has become acute since the formation of a badly polluted 4½-mile pool back of the dam in the Mississippi River in front of the two cities. Large masses of floating sludge are not uncommon and sludge deposits varying from 3 to 12 ft. deep are found. The total equivalent waste of people and industries amounts to 1,250,000 persons. Twenty possible projects with various sites, all within the riverbanks, have been studied. Further progress depends on state legislation giving permission to form an inclusive sanitary or drainage district.

Fourteen out of 48 cities with a population of 25,000,000 have trouble with aftergrowths in their water supplies after purification, said John R. Baylis, chairman of a committee on water supply. How much is due to increase and how much to pollution is unknown. More study was urged of open reservoirs, though enough information is available to throw doubt on the wisdom of using open reservoirs without subsequent chlorination. Chlorinated copperas came in for much discussion, since it is found that in certain cases its use will materially reduce the cost of coagulating chemicals.

In his presidential address Mr. Fuller laid down the following principles of procedure which would give a more efficient control of public health activities:

1. Reorganize the A.P.H.A. to bring about stabilization of administration; clarification of the authority and the allocation of responsibility of its officers; and the establishment of better methods of financing and program making.
2. Lessen the overlapping of efforts by voluntary health agencies, by securing support for specific undertakings recommended by the health officers' group.
3. Provide an effective and scientific organ with popular appeal for expression on problems of today that affect public health.
4. Endeavor to promote better relations between medical practitioners and public health workers.
5. Strengthen the position of the A.P.H.A. in matters of research and standards, and after giving due consideration to various problems, concentrate upon the most timely and necessary ones, with a view to developing them into specific projects. Secure more adequate financial support for such undertakings from sources that will not compromise our independence, self-respect or dignity.
6. Put the responsibility on the administrative health officers for strengthening their strictly professional activities in this association, giving them ample opportunity to develop and exercise leadership in the affairs of A.P.H.A.; for concentrating on topics that are most helpful and valuable to them and to their communities; and then expect of them the full discharge of their responsibilities.

In line with these commendations constitutional amendments were voted on favorably. A definitely formulated program of the major activities for the ensuing year is called for with an allocation of funds to carry them out. The position of executive secretary is dropped; most of his duties are to be taken over by the chairman of the executive board elected by the board. Dr. A. J. Chesley, executive health officer, Minnesota State Board of Health, St. Paul. The newly created office of president-elect will be filled by Surgeon-General H. S. Cummings, U. S. Public Health Service, Washington, D. C.

Data and Forecast

A spot of sunshine broke through the clouds this week when the pace of steel production quickened 3 per cent. In view of conditions in the automobile field, it would be surprising if there could be much increase in steel activity soon. . . . Money rates are high and no real prospect for cheaper money appears. Last week saw rates tighten in Europe. . . . September saw the largest decline of the year in the stock market. Yet funds absorbed by speculation increased. Time funds rule at 9 to 9¼ per cent, equal to the highest rate in recent years. . . . Demand for funds by industry, business and speculation shows no signs of abatement, either in the public markets or from the banks. New financing for the first nine months of the year has totaled approximately seven billions, about the same as last year . . . The domestic credit demand has been such that we no longer lend appreciable amounts for foreign countries. . . . But for the present business is quite safe, and holds steady.

Consensus of Field Reports

Every section of the country, except the east south central states, will do a better volume of business than last year, the Chicago and South Atlantic section leading with a gain of 8 per cent.—The Council on the Trend of Business.

—The Business Week, Oct. 5

First Bids for Tri-Borough Bridge to Be Called

Award of contracts for certain foundation work on the Tri-Borough bridge which is to connect Manhattan, the Bronx and Queens, New York City, was authorized by the Board of Estimate Oct. 3. The work which will be started at this time is limited to the foundations situated upon city or state owned property, and will cost, according to preliminary estimates, $1,150,000. It will include towers and piers erected on Ward's and Randall's Island and in the Astoria section of Queens.

Changes in the location of the structure have increased the length of the main span from 1,100 to 1,380 ft., with corresponding increases in lengths of the approaches. The portion over Little Hell Gate will consist of two steel arch spans, each 375 ft. in length with a pier in the center of the waterway. The total length of the main bridge has been increased from 12,700 ft. to 13,560 ft. Two roadways 40 ft. wide will be provided, with provision for future double-decking when the volume of traffic demands. The main span, over Hell Gate, will have a vertical clearance of 135 ft. above main high water, the same as the rest of the East River bridges. Clearance over the Harlem River will be 55 ft. at main high water. A connection from Second Avenue and 125th Street, Manhattan, to the main bridge will be 4,150 ft. long with provision for six lanes of traffic.

State Sanitary Engineers Hold Minneapolis Meeting

Twenty-five of the 45 states having state sanitary engineers were represented at the tenth annual Conference of State Sanitary Engineers Sept. 28 to Oct. 1 at Minneapolis. This was a greater proportion than had heretofore been present, testifying to the wise judgment of the organization in holding its sessions with the American Public Health Association. A unanimous vote on place of next year's meeting calls for a similar arrangement. While it was the sense of those present that a sewage census be taken in 1930, a letter ballot on the subject will be taken, since this census will not be of much value nationally unless it is generally taken in all of the states.

The conference, after listening to an exhaustive report on cross-connections in water supplies, again went on record as being opposed to any cross-connections between safe drinking water supplies and other sources. It urged that control by state and local authorities be inaugurated where it does not now exist. Further, it recognized that inadequacy of municipal water distribution systems is frequently a barrier to complete elimination and urged the extension of such systems. With reference to the stop-and-start chlorinators on fire connections the conference committee feels that the chlorinator in this capacity is too new to warrant further comment other than that it might be compared to a third check valve.

After a review of methods of handling permits for sewage-treatment plants in the various states, V. M. Ehlers, Texas, in his committee report on that subject recommended that plans should always be submitted (Maine, Utah and Florida do not have such requirements) and that while the specific basis of design need not be submitted, yet local data should be furnished from which such bases may be determined.

A difference of opinion arose as to the use of highway signs indicating approved tourist camps and water supplies. Illinois has stopped the practice, as have several other states, but in some states it has been the only weapon to make camps clean up. The matter arose when approval was asked for signs submitted by the U. S. Bureau of Public Roads. A motion to approve the signs was tabled, apparently because the delegates felt that action would be interpreted as meaning that the conference had a policy on the question rather than on the design of the signs.

The following officers for the ensuing year were elected: chairman, Abel Wolman, Baltimore, Md.; vice-chairman, F. H. Waring, Columbus, Ohio; members of executive committee, X. H. Goodenough, Boston, Mass.; and E. D. Rich, Lansing, Mich.; secretary-treasurer, R. E. Tarbett, U. S. Public Health Service, Washington, D. C.

Plans for New York's 180-M.G.D. Sewage-Works Approved

Project plans for the proposed 180,000,000 gal. daily activated-sludge plant at Ward's Island, New York City, were approved by the Board of Estimate and Apportionment on Oct. 3 and now go to the state Department of Health for its approval. The plans were drawn by Fuller & McClintock, New York City, as the first step under the $605,000 contract outlined in *Engineering News-Record*, Dec. 6, 1928, p. 851. Final plans for a dock and sea wall and for aeration tanks have been submitted for the approval of the Borough President of Manhattan and those for the preliminary and final settling tanks are practically complete. No dates have yet been fixed for receiving bids. A large group of specialists is co-operating in the preparation of the plans, including Pearse, Greeley & Hansen, Chicago, on the settling and aeration tanks. All construction work will be done under the Borough President of Manhattan, Julius Miller, in a special bureau headed by Richard H. Gould, under C. M. Pinckney, chief engineer, Borough of Manhattan.

Nashville's Filtration Plant Formally Dedicated

The new filtration plant of the Nashville (Tenn.) water-works was formally dedicated on Oct. 3, when the entire plant was thrown open for public inspection.

Contract for Intake Lagoon Let by Detroit Water Board

A contract for building a water intake lagoon at the head of Belle Isle was awarded by the water board of Detroit, Mich., on Oct. 2 for $488,215 to the Dunbar & Sullivan Dredging Company of Detroit. Further information has been supplied by F. H. Stephenson, engineer of water system, as follows:

Water from the Detroit River near the outlet of Lake St. Clair will flow into a narrow lagoon about 2,500 ft. long and varying in width from 280 ft. at its entrance to 480 ft. at its lower end. At the lower end of the lagoon there will be a masonry intake structure into which water will flow and be conducted by the intake shaft and intake tunnel to the mainland, and thence by other tunnels to the purification plants and pumping stations.

The lagoon type of construction was decided upon after considerable study involving estimates of time required to build, freedom from ice troubles, acceptability for operation and connection with the existing system, hazards to navigation, etc. It is believed that at least one year can be saved in construction over the next best proposed scheme which would involve a much longer intake tunnel with its end located in Canadian territory.

Brief News

BUILDING REGULATIONS of communities do not apply to state structures in those communities, is the ruling by Attorney-General Brucker of Michigan. The city or village, existing only by authority of the state, has no jurisdiction over building operations on state lands, Mr. Brucker declares.

THE LARGEST PILE-DRIVING EQUIPMENT of British make, according to *The Engineer*, London, has been put to work by the South Australian Harbours Board. The machine handles reinforced-concrete piles 24 in. square, 70 ft. long, weighing up to 15 tons. It works by steam, and has a striking blow of 5 tons.

ATLANTA'S MUNICIPAL WATER-WORKS are not for sale, Mayor Ragsdale has informed Oliver P. Cobb & Company, of Paducah, Ky., in a letter replying to an offer of that concern to buy the property.

INCORPORATION of Rochester, Mich., as a city was defeated by the voters of the village in a special election on Sept. 30, by a vote of 528 to 57. A proposition to issue bonds for $72,000, to construct sewers, was beaten for the third time in a year by a vote of 287 to 286.

THE STONO RIVER BRIDGE, a 1,780-ft. structure, 18 ft. wide, which will bring Johns Island, off the South Carolina coast, several miles closer to Charleston, will be begun in the immediate future. The contract for the main structure has been awarded to the Salmons-Clement Company, of Charleston, S. C., and that for the steel draw span to the Greenville (S. C.) Steel & Foundry Company. The proposed span will be a toll bridge of creosoted timber with a steel draw span.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Army Engineers Reassigned—Plan North-South Railway in West—Chicago Water Case

NEW assignments which have been announced in the Corps of Engineers carrying out the decentralization plan suggested by the President beat out predictions to the effect that the necessary reorganization would be worked out with a minimum of change. What is regarded as the most outstanding departure from the existing set-up is the decision to move the headquarters of the Mississippi River Commission from St. Louis to the center of flood-control operations in the lower valley at Vicksburg. By designating General Jackson, president of the Mississippi River Commission, as the engineer officer to supervise the field work in connection with flood-control operations in the lower river the necessity of obtaining the consent of Congress to curtail the powers of the commission is obviated. Under the existing law the commission is given the power to carry out the flood-control program and the selection of any other engineer officer than the president of the commission to assume local authority would have necessitated a change in legislation.

Formerly the president of the Mississippi River Commission has served also as the division engineer of the Western Division, but in increasing General Jackson's duties in connection with the flood-control work it was decided to relieve him of any other duty. The headquarters of the Western Division are in St. Louis.

Other Projects

The two other projects mentioned by the President in his decentralization program are the navigation improvement work on the Mississippi tributaries and the proposed deep-water routes connecting the Great Lakes with the sea. The field work for the inland waterway improvement on the Missouri, the Ohio and the upper Mississippi will be supervised by Lieut. Col. George R. Spalding, former district engineer at Louisville. Colonel Spalding will carry out this work as division engineer of the Upper Mississippi Valley Division, with headquarters at St. Louis. The Upper Mississippi Valley Division combines the former Central Division, which had its offices in Cincinnati, with the former Western Division.

The third project mentioned by the President for decentralized direction, the work on the Great Lakes, has been placed under the charge of Col. Edward M. Markham. Headquarters for this work will be at Cleveland. Colonel Schulz has been relieved of his post as division engineer at Cleveland and will take over Colonel Markham's former duties as commanding officer of the engineer camp at Fort Humphreys, Va. With the discontinuance of the Central Division, Colonel Ferguson has been relieved of his duties as head of this division and will assume direction of the activities of the South Atlantic Division, with offices in Norfolk.

Hudson Bay-Mexico Railroad Proposed

A north-and-south transcontinental railway system is visualized by the Wyoming Montana Railroad, which filed an application with the Interstate Commerce Commission on Oct. 3 for authority to construct 631 miles of line, at an estimated cost of $27,078,550, that would connect Miles City, Mont., and Craig, Colo. Hugh L. Kirby, president of the road, stated that the management expects eventually to build north to a connection with the Canadian National in Saskatchewan.

The present plan embraces completion of the projected and partly constructed line from Miles City south to Casper, Wyo., 312 miles, now in the hands of the North & South Railway, and construction of an extension from Casper to Craig, 249 miles. Purchase of the 41-mile segment now in operation between Midwest and Illco, Wyo., will bring the total cost of the project up to $32,100,000. Between Illco and Casper the North & South Railway has trackage rights over the Chicago & Northwestern, and the latter has agreed that the Wyoming Montana shall take over the contract. A trackage right agreement negotiated with the Denver & Salt Lake will provide access to Denver, and the carrier's application states that it is now negotiating for traffic connections at Denver with the Santa Fe and the Rock Island.

Railway Acquisition Recommended

Acquisition by the Baltimore & Ohio Railroad of control of the Buffalo, Rochester & Pittsburgh Railway should be approved subject to the condition that the stock purchased from the Alleghany Corporation for $14,263,216 shall be held in such a manner as will readily permit control of the road to be transferred elsewhere if the Interstate Commerce Commission so elects, C. V. Burnside, assistant director of the commission's bureau of finance, recommended Oct. 2 in a proposed report on the B. & O. application.

Great Lakes Diversion

Final arguments on the Chicago diversion case were heard before Special Master Charles Evans Hughes last week in Washington, and it is expected that the decree will be recommended to the Supreme Court in the near future. The decision of the Supreme Court last January refrained from entering a decree stating just what the Sanitary District must do. In all probability the matter will not be ended when the special master submits his recommendations for an official court order, as either side will be permitted to file exceptions to Mr. Hughes' report, and there is little doubt that one side or the other will take the final step.

Newton D. Baker, former Secretary of War, made the closing plea for the Lake States before Mr. Hughes. In presenting his case Mr. Baker submitted a decree which the Lake States had drawn up and which they would like the Supreme Court to adopt. In the proposed decree it is required that all diversion from Lake Michigan by the Sanitary District be stopped by 1935 and that the withdrawal be decreased gradually up to that time. Specifically diversion would be cut to 6,500 sec.-ft. by April, 1930; to 5,000 sec.-ft. by Dec. 31, 1932; to 3,000 sec.-ft. by Dec. 31, 1933, and would cease entirely by Dec. 31, 1935. Another point suggested in the decree presented by the Lake States is that the defendants be required to pay the cost of the entire court proceedings. Since the present suit was started in 1923, it is apparent that the costs will reach a high total.

Replying to the claim of Chicago representatives that it will be difficult to get the city's water supply 20 miles away, Mr. Baker recalled that Los Angeles must go 235 miles for its water, San Francisco 254 miles, and New York 120 miles. He also pointed out that the cost per capita for the new works to the citizens of Chicago will amount to approximately $32, as against $118 in New York. To the contention of the Sanitary District that the projects will cost $176,000,000, the Lake States reply that it will cost only $80,000,000 for the total amount of work necessary.

War Department Criticised

During the final days of the hearings the part played by the War Department came in for some criticism by Hamilton Ward, Attorney-General of New York. Mr. Ward made the charge that it was very largely the War Department's failure to handle the situation successfully that forced the issue to be taken to the courts. Wilber M. Brucker, Attorney-General of Michigan, who was one of the last to speak for the complainants, denied that the present high level of water in the Great Lakes makes the issuance of a decree unnecessary. This had been contended previously by representatives of the Sanitary District. In support of his statement, Mr. Brucker said that although a cycle of high water seems to be setting in, its peak is lower than that of the other high cycles that have occurred since 1860. He expressed the opinion that the present high level of Lake Michigan is largely the result of the artificial lowering of Lake Superior since last September through the pumping of great quantities of its water into the lower lakes.

In presenting Chicago's version of the case, representatives of the Sanitary District stated that it will require fifteen or twenty years and the expenditure of $176,000,000 to construct the sewage-disposal works and that engineers who testified that the project

could be completed sooner were either men of meager technical experience or else knew little of the peculiar conditions pertaining to Chicago. George F. Barrett, attorney for the Sanitary District, reminded Mr. Hughes that since the major portion of testimony in the case was taken the water levels in every one of the Great Lakes have risen. Mr. Barrett not only stated that the levels of Lakes Erie and Huron have risen 45 in., but he also called attention to figures showing that the level of Lake Michigan is 20 in. higher than it was at the time the Chicago Sanitary Channel was opened. Every harbor on the Great Lakes now has a greater actual depth than the project depth set by the Corps of Engineers, he said. As to the taxation that the work will impose on the citizens of Chicago, he declared that the per capita taxes in that city during the next two years will be higher than anywhere else in the world.

The suggestion was advanced on the part of one of the representatives of Chicago that rather than go on with the case in the Supreme Court, the decision of the nature of the work that the Sanitary District must do be left to the War Department.

Personal Notes

RALPH J. REED has resigned as chief engineer of the Union Oil Company of California. In his long service with this company Mr. Reed has had charge of design and erection of extensive reservoirs, pipe lines, refineries and manufacturing plants.

M. W. SHUIT, of St. Albans, W. Va., who last May left the Kanawha County (W. Va.) road department, where he was resident engineer of construction, to take a position of mine foreman at Keystone Mine No. 2 of the Koppers Coal Company at Keystone, W. Va., has returned to the Kanawha County road department as resident engineer.

RICHARD R. LYMAN has resigned as a member of the Colorado River Commission for Utah. Mr. Lyman was recently appointed consulting engineer for the Metropolitan Water District of Southern California on a board of review of the several proposed routes of the Colorado River aqueduct as a part of the Boulder dam project.

ALEXANDER H. NELSON, of Atlantic City, N. J., has been appointed chief engineer by the South New Jersey Traffic Commission, with headquarters at Camden, N. J. This commission was named by the Governor, under authority of an act of the legislature, to investigate and report on co-ordination and extension of existing high-speed traffic facilities in southern New Jersey.

H. A. STRINGFELLOW, sales engineer with the Biggs Boiler Works and previous to that chief engineer of the water department of Barranquilla, Colombia, South America, has accepted a position as sales engineer with the Southwark Foundry & Machine Company, Philadelphia. Mr. Stringfellow was at one time assistant engineer for the late R. Winthrop Pratt, in charge of water-works investigations at Detroit, Mich., and later was associated with Wynkoop Kiersted, consulting engineer, Kansas City, Mo.

ELMER E. BARNARD, formerly chief engineer of the Lynchburg Traction & Light Company, Lynchburg, Va., and the Roanoke Railway & Electric Company, Roanoke, Va., has resigned those positions and is opening offices as a consulting engineer in Lynchburg.

JEFFERSON B. DAVIS, who for some time was with the Foundation Company, has become associated with the Domill Construction Company, a subsidiary of the International Paper & Power Company, and is in charge of the construction of the Temiscouta dam at Ste. Rose du Degele, Quebec, Canada.

JACK H. RAFFERTY, of Houston, Tex., formerly instructor in municipal engineering at Rice Institute and now city engineer of West University Place, has been selected as sewer engineer of La Porte, Tex.

ALEXANDER J. TAYLOR, former city engineer of Wilmington, Del., and now consulting architect of the Delaware School Foundation, has been elected president of the foundation and also president of the Delaware School Auxiliary. The auxiliary was founded ten years ago by Pierre S. du Pont to build new schools in Delaware. The foundation was organized several years ago to give architectural and engineering aid to the State of Delaware in its $2,000,000 school building program.

Society Calendar

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington: annual meeting, San Antonio, Tex., Nov. 12-15.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, New York: annual convention, Biloxi, Miss., Nov. 13-16.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION, Chicago: annual meeting, New Orleans, La., Oct. 15-17.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis: annual convention, Philadelphia, Pa., Oct. 14-18.

ASPHALT PAVING CONFERENCE, New York City: annual meeting, West Baden, Ind., Oct. 28-Nov. 1.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago: annual conference, Jacksonville, Fla., Oct. 14-16.

INTERNATIONAL CITY MANAGERS ASSOCIATION, Chicago: annual convention, Fort Worth, Tex., Nov. 20-23.

NATIONAL PAVING BRICK MANUFACTURERS ASSOCIATION, Washington: annual meeting, Chicago, Ill., Dec. 4-6.

SOUTHWEST WATER WORKS ASSOCIATION, Fort Worth, Tex.: annual convention, Tulsa, Okla., Oct. 28-30.

CITY OFFICIALS DIVISION, American Road Builders Association, Washington: airport meeting, Washington, Oct. 24-25.

IOWA SEWAGE TREATMENT CONFERENCE: annual meeting, Ames, Iowa, Oct. 22-24.

MISSOURI WATER AND SEWERAGE CONFERENCE: annual meeting, Chillicothe, Mo., Oct. 21-23.

NEW YORK STATE SEWAGE WORKS ASSOCIATION, Albany: fall meeting, Schenectady, N. Y., Oct. 19.

OHIO CONFERENCE ON SEWAGE TREATMENT: annual meeting, Canton, Ohio, Oct. 22-23.

OHIO WATER PURIFICATION CONFERENCE: annual meeting, Columbus, Ohio, Oct. 24-25.

Obituary

WILLIAM J. KROME, construction engineer on the Key West extension of the Florida East Coast Railway, died at his home in Homestead, Fla., on Oct. 2. He was 53 years old.

CHARLES RONALD MACINNESS, professor of mathematics in the engineering school at Princeton University, died in the Pennsylvania Hospital, Philadelphia, on Sept. 29. Dr. MacInness, who was born 51 years ago in Lancaster, Ont., joined the department of mathematics at Princeton in 1905. He was the author of textbooks on mechanics and trigonometry for the use of engineering students.

DAVID LYNDE HUNTINGTON, for the past nineteen years president of the Washington Water Power Company and subsidiary companies in Spokane, Wash., died Sept. 27. Mr. Huntington was a pioneer in the hydro-electric industry. Following his graduation from Yale University, he entered the employ of the Thomson-Houston Electric Company in 1891. In 1892 he became affiliated with the General Electric Company as assistant engineer at Philadelphia. In 1894 he left that company's employ to become treasurer of the Washington Water Power Company and became general manager in 1896, vice-president and general manager several years later, and in 1910 he was elected president. He was president of the Spokane United Railways since its organization July 1, 1922.

WILLIAM F. WILLIAMS, Massachusetts State Commissioner of Public Works from 1922 to 1928, died suddenly on Oct. 1. Mr. Williams, who was a graduate of Columbia University, was city engineer of New Bedford, Mass., for twenty years. In 1912 he became chief engineer of the old Massachusetts State Board of Harbor and Land Commissioners, later the Commission on Waterways and Public Lands, and was also engineer for the Public Service Commission during the construction of the Cape Cod Canal. Mr. Williams had made studies and designs for the improvement and development of practically every harbor in the commonwealth, outside of Boston, from Newburyport to Westport. He also was in charge of the rivers in the state. He was in charge of a survey of the water resources of the commonwealth. Since his retirement Mr. Williams had been active as a member of the commission appointed by Governor Allen to investigate grade crossings throughout the state, and was consulting engineer for two overlapping commissions concerned with sewage disposal in Boston harbor and a study of the Fort Point Channel.

Construction Equipment and Materials

Market Practices Considered by Reinforcing Steel Institute

At the semi-annual meeting of the Concrete Reinforcing Steel Institute held at Wawasee, Ind., Sept. 30 to Oct. 2, the main topic of discussion was the recent approval by the Federal Trade Commission of the business practice rules adopted at Asheville last April, and the effect of this action upon marketing practices. It was held that the publishing of and close adherence to price lists might be required by the association of each of the member companies, and this action was favored. Open publication of prices would tend to stabilize the market and mitigate many of the evils which have attended unrestricted competition. The industry was also advised to adopt the practice of permitting but a single closed bid on any one job by any firm.

Many committee reports were received and discussed at the meeting. J. T. Thompson, formerly employed by the Portland Cement Association, was appointed assistant engineer for the Institute, with headquarters in offices to be opened in New York City. The Institute accepted the offer of an award by an anonymous donor to be presented at the next annual meeting in the name of the Institute as a mark of recognition for service rendered the industry.

Bitumastic Lining for Cast-Iron Pipe Applied Centrifugally

A demonstration of a centrifugal process of lining cast-iron pipe with Bitumastic enamel, developed by engineers of the Wailes Dove-Hermiston Corporation and the United States Pipe & Foundry Company, was given before a group of 50 hydraulic and municipal engineers Sept. 24 at the pipe company's plant at Burlington, N. J. Although Bitumastic lining for pipe is not new, its widespread use has been retarded by the slow, tedious and costly hand method of application. The centrifugal process promises a method of application that is efficient, rapid and economical. Although the demonstration was confined to lining 48-in. pipes, it is claimed that the process is applicable to all sizes from 4 in. upward.

In applying the Bitumastic enamel lining by the centrifugal process the pipe to be lined is rotated rapidly on four rollers operated by an electric motor. The pipe is previously primed with a tar coat by dipping and is allowed to dry thoroughly. The Bitumastic enamel is heated in a kettle and transferred to a steam-jacketed trough the same length as the pipe section. The trough is then inserted within the revolving pipe and dumped, the bitumen spreading evenly around the entire inside area to a depth of 3/32 in. Before the pipe has stopped rotating the lining hardens with a glossy finish of remarkable smoothness resembling baked enamel. If a heavier lining is desired, the process is repeated, a perfect bond being formed between the two coats. Pipe may be handled and loaded immediately after lining.

The tenacity of the lining was demonstrated by tapping a section with a 2-in. tap, and cutting another section with a cold cut and hammer. In both cases but little chipping of the lining occurred. The manufacturers claim the Bitumastic enamel will successfully resist acids, alkalis and corrosive liquids, and that the smooth surface will cut down friction losses and prevent the formation of tubercles.

Explosives Laboratories Planned

Experimental research work for the Hercules Powder Company will soon be concentrated in a new station to be erected about 2½ miles west of Wilmington, Del., according to plans announced by the company. The 300-acre site will be occupied by a main building containing chemical laboratories, offices and a library, supplemented by auxiliary buildings housing experimental plants. A power house and storerooms will also be provided. As soon as the station is completed the experimental staff and all research equipment of the company will be moved in from the present station at Kenvil, N. J.

Costs and Contracts

E. N.-R. Index Numbers

Cost			Volume		
Oct. 1,	**1929**	**206.32**	**Sept.,**	**1929**	**340**
Sept. 1,	1929	207.57	August,	1929	290
Oct. 1,	1928	207.71	September,	1928	296
Average,	1928	206.78	Average,	1928	287
Average,	1927	206.24	Average,	1927	263
1913.....		100.00	1913.....		100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of Oct. 10, with some comparisons, total as follows:

(In Thousands of Dollars)

	Oct. 10, 1929	Oct. 3, 1929	Oct. 11, 1928
Building:			
Industrial	$2,859	$2,972	$2,674
Commercial	19,015	43,713	20,720
Streets and roads	10,992	13,062	10,429
Other eng. constr.	14,751	8,942	49,282
Total	$47,617	$68,689	$83,105
Total, all classes, Jan. 1 to Oct. 10:			
1929			$3,337,811
1928			2,853,275

Three Steel Companies Merge

The Great Lakes Steel Corporation, the Weirton Steel Company and the M. A. Hanna Company, of Cleveland, Ohio, have been merged under the direction of a holding company to be formed with assets of $150,000,000. George A. Fink, president of the Great Lakes company, will be president of the combined organization; E. T. Weir, president of the Weirton company, will be chairman of the board of directors, and George M. Humphrey, of the Hanna company, will be chairman of the executive committee. It is stated that the assets and ore reserves thus united will be exceeded only by those of the United States Steel Corporation and the Bethlehem Steel Corporation.

Business Notes

ARKANSAS PORTLAND CEMENT COMPANY on Oct. 2 opened its new $2,500,000 plant at Okay, Ark., 15 miles southeast of Nashville, Tenn. The present output of 2,200 bbl. daily will be doubled by Jan. 1, according to present plans.

NATIONAL PORTLAND CEMENT COMPANY is planning to build a new plant at Vicksburg, Miss., at an estimated cost of $1,000,000.

CHAIN BELT COMPANY, Milwaukee, Wis., has appointed Hibbard S. Greene, formerly vice-president and director of the Barber-Greene Company, assistant to the president of the Chain Belt Company.

CONSOLIDATED EXPANDED METAL COMPANIES, Wheeling, W. Va., has appointed L. W. Sprickman manager of its Buffalo office and warehouse, to fill the vacancy caused by the transfer of C. V. Vigor to the main office.

DEWALT PRODUCTS CORPORATION, Leola, Pa., has appointed Walter Knapp executive engineer at its plant.

INDEPENDENT PNEUMATIC TOOL COMPANY, Chicago, Ill., has appointed R. E. Kelly sales engineer for its Eastern district, with headquarters in New York. Mr. Kelly was formerly manager of the Boston office and will be succeeded there by John Ashton.

RED CEDAR SHINGLE BUREAU has affiliated with the National Lumber Manufacturers Association as the result of an agreement signed Sept. 14.

MARQUETTE CEMENT MANUFACTURING COMPANY has appointed Charles Peyton general sales manager to succeed Paul R. Price, resigned.

New Publications

Sheet Steel—U. S. BUREAU OF STANDARDS, Division of Simplified Practice, has revised Simplified Practice Recommendation No. 28—Sheet Steel. Copies of the new booklet may be procured from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 10c. each.

Drainage—W. S. DICKEY CLAY MANUFACTURING COMPANY, Kansas City, Mo., in a 55-p. illustrated booklet treats of the methods used in the underdrainage of golf courses, airports and other areas. Information is given as to proper methods of installation for drainage systems.

Locomotive Cranes—THEW SHOVEL COMPANY, Lorain, Ohio, in a 15-p. illustrated booklet gives specifications and complete descriptions of the 15- and 20-ton Lorain locomotive cranes powered by gasoline, electric or diesel motors.

Lubrication System—LUBRICATION DEVICES, INC., Battle Creek, Mich., presents "A Picture Story of Farval" in a 15-p. booklet containing many illustrations and colored diagrams. Farval is a centralized system of lubrication for application to machinery of any type or size.